TOSHIBA
Leading Innovation

System Catalog 2012-12

Semiconductors for Power Supplies

SEMICONDUCTOR & STORAGE PRODUCTS

http://www.semicon.toshiba.co.jp/eng

Power Supply Circuit Types and Their Applications

Toshiba offers various semiconductor devices for power supply applications to meet a wide range of customer needs varying from low power to high power. These devices help to save energy and improve power efficiency.

Technical Trend of Switching Regulators

System Trend	Circuit Technology Trend	Requirements for Semiconductor Devices
Lower loss / higher efficiency	Use of synchronous rectification	Reduced Ron and improved speed of power MOSFETs Improved V_F-I_{RRM} tradeoffs of SBDs
Higher frequency	Transition from PWM switching to resonant and interleaved switching	Reduced input capacitance of power MOSFETs Improved V_F-I_{RRM} tradeoffs of SBDs
Smaller and thinner form factors	Dispersed power sources (modular design)	Thermally enhanced packages (WCSP, BGA)
Noise reduction Harmonic requirements	Active filter	PFC controller ICs
Safety standards	Isolation of control and power units	Photocouplers (reinforced insulation, reduced power consumption)
Load transient response	Improvement in high-frequency characteristics Parallel power sources Digital control	Improved output accuracy Wider input and output voltage ranges Digital controller ICs
Smart systems	Hot swap	MOSFETs with logic inputs ORing MOSFETs

Technical Trend of Linear Power Supplies (LDO Regulators)

System Trend	Circuit Technology Trend	Requirements for Semiconductor Devices
Lower loss	Lower circuit voltage	Low dropout voltage
Output voltage regulation	Higher output voltage accuracy	Low output noise voltage Circuit with fast load transient response High ripple rejection ratio Automatic output discharge Overcurrent protection circuit
Smaller form factor Thinner form factor	Smaller system size Dispersed power sources	Development of a ultra-small package Small packages Packages with electrodes on the bottom

Contents

AC-DC Flyback Power Supplies

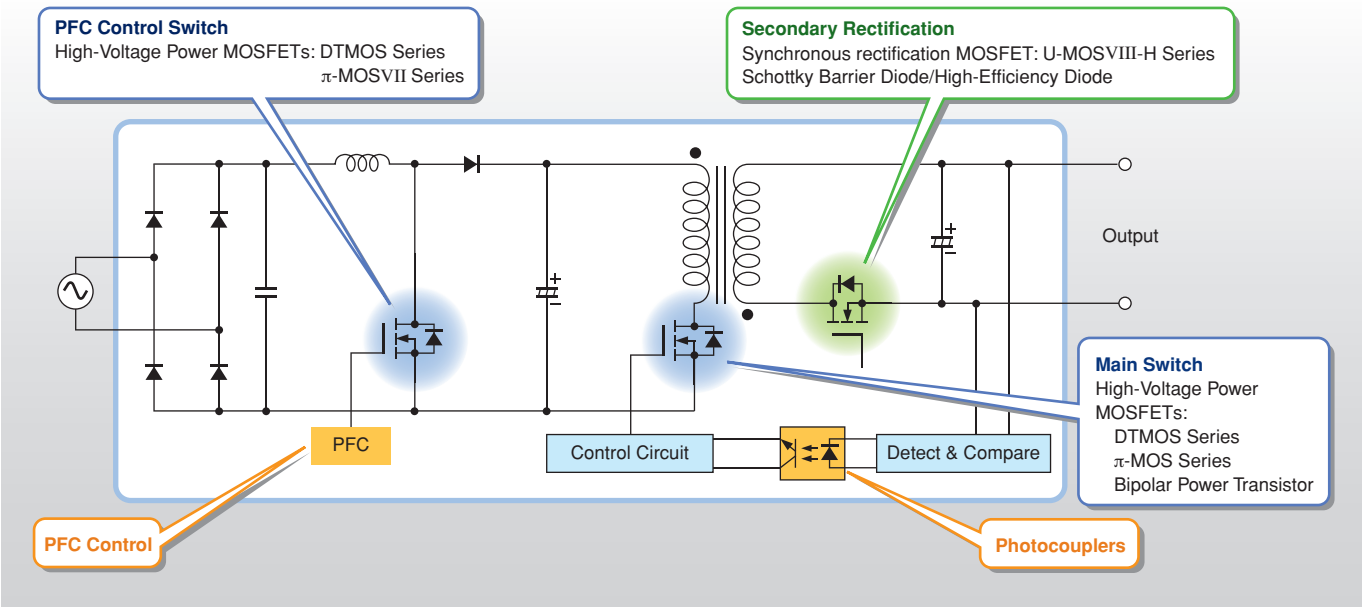
Features

- AC-DC flyback power supplies have a very simple circuit configuration that consists of a minimal part count. They are suitable for low-power power supplies.

Application Examples

- Notebook PCs
- LCD adaptors
- Power supplies
- Chargers for portable products
- PC peripherals
- Standby power supplies and small adaptors

Circuit Example



Recommended Parts

Output Power (W)			Up to 10	10 to 20	20 to 50	50 to 100
PFC Control	PFC Controller ICs		TB6819AFG			
PFC Control Switch	High-Voltage Power MOSFETs	V_{DSS} = 500 V	TK3P50D, TK4A50D, TK4P50D	TK6A50D, TK7A50D, TK7P50D	TK8A50D, TK10A50D, TK11A50D	TK12A50D, TK13A50DA, TK13A50D
		V_{DSS} = 600 V	TK5Q60W**, TK5P60W**, TK5A60W**	TK6A60D, TK7P60W**, TK8A60W**	TK10A60D, TK6A60W**, TK7A60W**	TK10A60D, TK10A60W**, TK16A60W**
Main Switch	High-Voltage Power MOSFETs	V_{DSS} = 600 V	TK5Q60W**, TK5P60W**, TK5A60W**	TK6A60D, TK7P60W**, TK8A60W**	TK10A60D, TK6A60W**, TK7A60W**	TK10A60D, TK10A60W**, TK16A60W**
		V_{DSS} = 650 V	TK3A65DA, TK4A65DA, TK5A65DA	TK5A65D, TK6A65D, TK7A65D	TK7A65D, TK8A65D	TK11A65D, TK12A65D, TK13A65D
		V_{DSS} = 900 V	TK1Q90A, TK1P90A, 2SK3301	2SK3564, 2SK3798	2SK3565, 2SK4014	2SK3799
	Bipolar Power Transistor	100-Vac input	2SC5548A, TTC008			
		200-Vac input	2SC6142, TTC012			
Secondary Rectification	Schottky Barrier Diode/ High-Efficiency Diode	Output: Up to 3 V (V_{RRM} = 30 V)	CUS10I30A, CRS10I30A, CRS10I30C	CRS20I30A, CRS20I30B, CMS20I30A	CRS30I30A, CMS30I30A	CLS01
		Output: Up to 5 V (V_{RRM} = 40 V)	CUS10I40A, CRS10I40A, CRS10I40B	CRS20I40A, CRS20I40B, CMS20I40A	CMS30I40A	CLS02
		Output: Up to 12 V (V_{RRM} = 60 V)	CUS04, CRS12, CRS13	CMS14	CLS03	
		Output: Up to 24 V (V_{RRM} = 200 V)	CRH01, CMH04, CMH07	CMH01, CLH01, CLH05		
		Output: Up to 48 V (V_{RRM} = 400 V)	CMH02, CMH05, CMH08	CLH03 CLH07		
	Synchronous Rectification MOSFET (Low-Voltage Power MOSFETs)	V_{DSS} = 100 V				TK40A10N1, TK65A10N1, TK40E10N1, TK65E10N1
		V_{DSS} = 120 V				TK56A12N1**, TK72A12N1**, TK56E12N1**, TK72E12N1**
Output Error Feedback	Photocouplers		TLP185, TLP291,TLP785			

**: Under development

AC-DC Forward Power Supplies

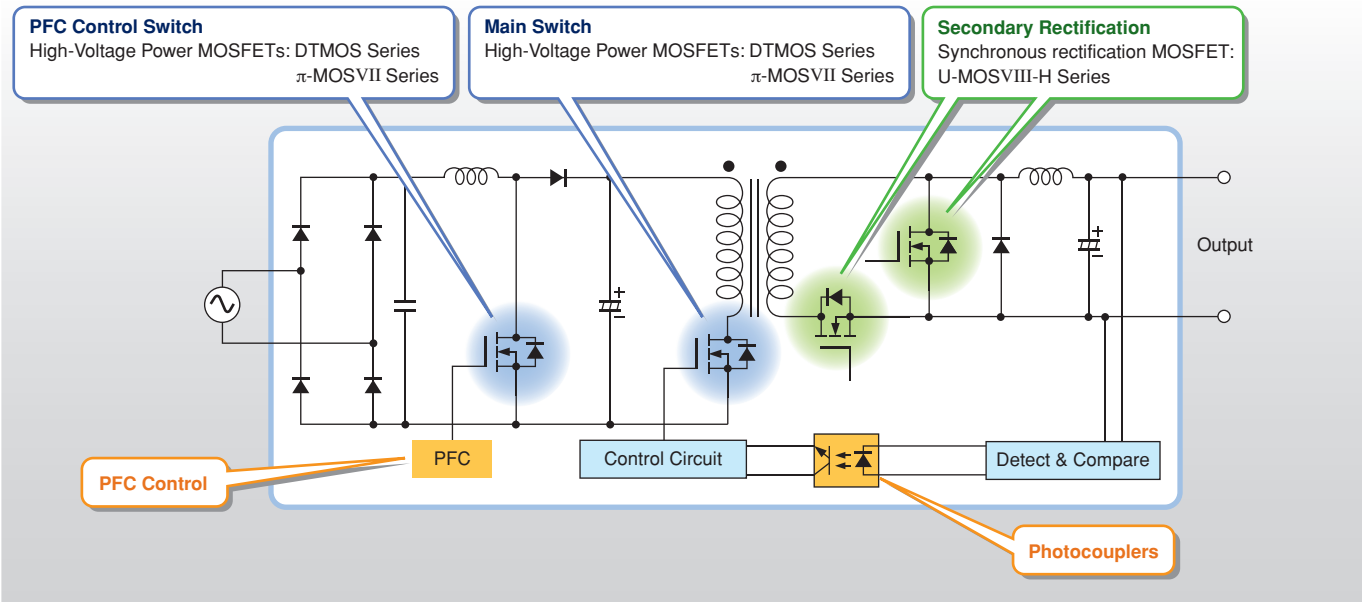
Features

- AC-DC forward power supplies with a relatively simple circuit configuration are widely used for 100-W to 500-W power supply applications. Forward power supplies have less ripple since the capacitor is continuously charged. Compared to flyback power supplies, they exhibit a higher transformer efficiency and thus can provide up to 500 W.

Application Examples

- Desktop PCs
- Power supplies for game consoles
- Multifunction printers
- Industrial power supplies

Circuit Example



Recommended Parts

Output Power (W)			Up to 100	100 to 150	150 to 200
PFC Control	PFC Controller ICs		TB6819AFG		
PFC Control Switch	High-Voltage Power MOSFETs	V_{DSS} = 500 V	TK12A50D, TK13A50DA, TK13A50D	TK13A50D, TK15A50D	TK15A50D, TK15J50D
		V_{DSS} = 600 V	TK10A60D, TK10A60W**, TK16A60W**	TK15A60D, TK16J60W**, TK31A60W**	TK16J60W**, TK31A60W**
Main Switch	High-Voltage Power MOSFETs	V_{DSS} = 600 V	TK10A60D, TK10A60W**, TK16A60W**	TK15A60D, TK16J60W**, TK31A60W**	TK16J60W**, TK31A60W**
		V_{DSS} = 650 V	TK11A65D, TK12A65D, TK13A65D	TK13A65U, TK13J65U	TK17A65U, TK17J65U
Secondary Rectification	Synchronous Rectification MOSFET (Low-Voltage Power MOSFETs)	V_{DSS} = 60 V	TK30A06N1, TK30E06N1	TK40A06N1, TK40E06N1	TK58A06N1, TK58E06N1
		V_{DSS} = 80 V	TK35A08N1, TK35E08N1	TK46A08N1, TK46E08N1	TK72A08N1, TK72E08N1
		V_{DSS} = 100 V	TK34A10N1, TK34E10N1	TK40A10N1, TK40E10N1	TK65A10N1, TK65E10N1
		V_{DSS} = 120 V	TK32A12N1**, TK32E12N1**	TK42A12N1**, TK42E12N1**	TK56A12N1**, TK56E12N1**
Output Error Feedback	Photocouplers		TLP185, TLP291,TLP785		

**: Under development

Switching Power Supplies

AC-DC Resonant Half-Bridge Power Supplies

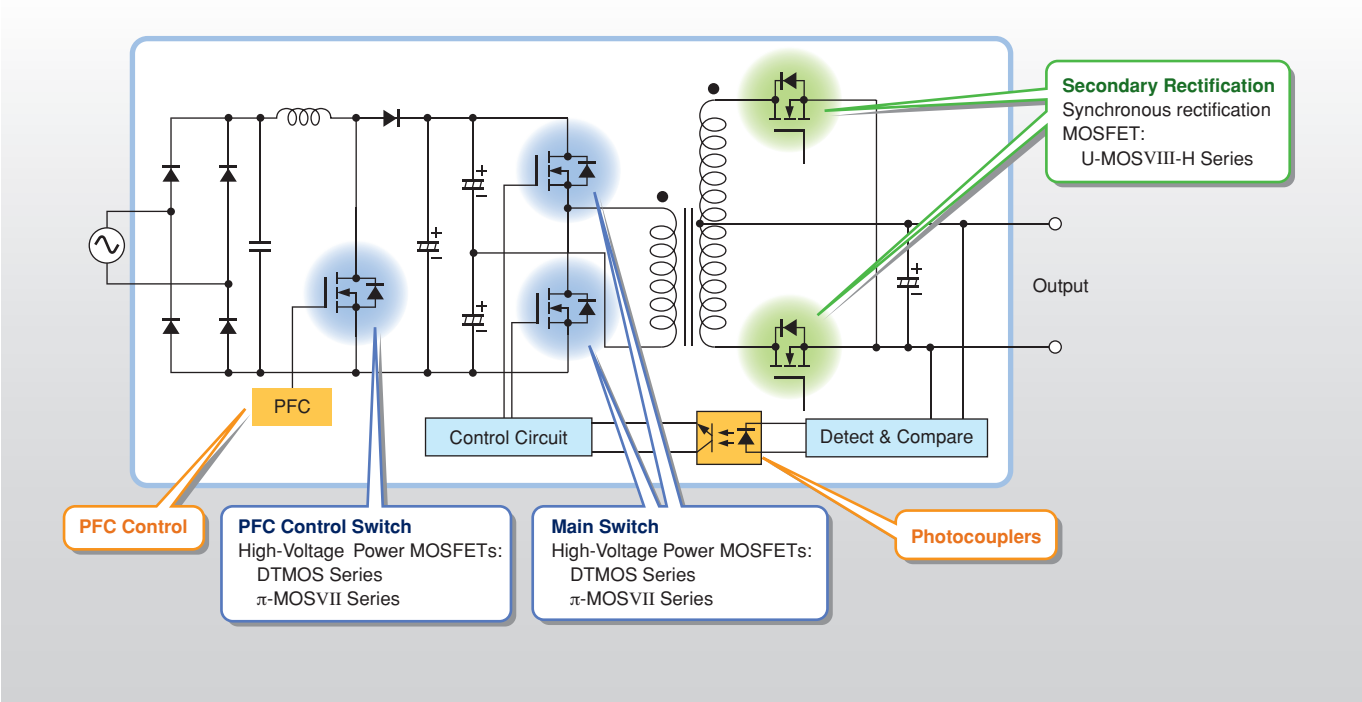
Features

- Resonant half-bridge power supplies are suitable for relatively high-power power supply applications in the range of 150 W to 1 kW. The two transistors connected in series with the input supply voltage reduce the input voltage applied to the primary side of the transformer by half. This makes it possible to use Low-Voltage transistors.

Application Examples

- Power supplies for FPD TVs
- Desktop PCs
- Servers

Circuit Example



Recommended Parts

Output Power (W)			Up to 100	100 to 200	200 to 400	400 to 800
PFC Control	PFC Controller ICs		TB6819AFG		TB6818FG	
PFC Control Switch	High-Voltage Power MOSFETs	V_{DSS} = 500 V	TK12A50D, TK13A50DA, TK13A50D	TK15A50D, TK15J50D	TK20J50D	
		V_{DSS} = 600 V	TK10A60D, TK10A60W**, TK16A60W**	TK16J60W**, TK31A60W**	TK31J60W**, TK39J60W**	TK39J60W**, TK62J60W**
Main Switch	High-Voltage Power MOSFETs	V_{DSS} = 500 V	TK12A50D, TK13A50DA, TK13A50D	TK15A50D, TK15J50D	TK20J50D	
		V_{DSS} = 600 V	TK10A60D, TK10A60W**, TK16A60W**	TK16J60W**, TK31A60W**	TK31J60W**, TK39J60W**	TK39J60W**, TK62J60W**
Secondary Rectification	Synchronous Rectification MOSFET (Low-Voltage Power MOSFETs)	V_{DSS} = 60 V		TK40A06N1, TK40E06N1	TK58A06N1, TK58E06N1	TK100A06N1, TK100E06N1
		V_{DSS} = 80 V		TK46A08N1, TK46E08N1	TK72A08N1, TK72E08N1	TK100A08N1, TK100E08N1
		V_{DSS} = 100 V		TK40A10N1, TK40E10N1	TK65A10N1, TK65E10N1	TK100A10N1, TK100E10N1
		V_{DSS} = 120 V		TK42A12N1**, TK42E12N1**	TK56A12N1**, TK56E12N1**	TK72A12N1**, TK72E12N1**
Output Error Feedback	Photocouplers		TLP185, TLP291, TLP785			

**: Under development

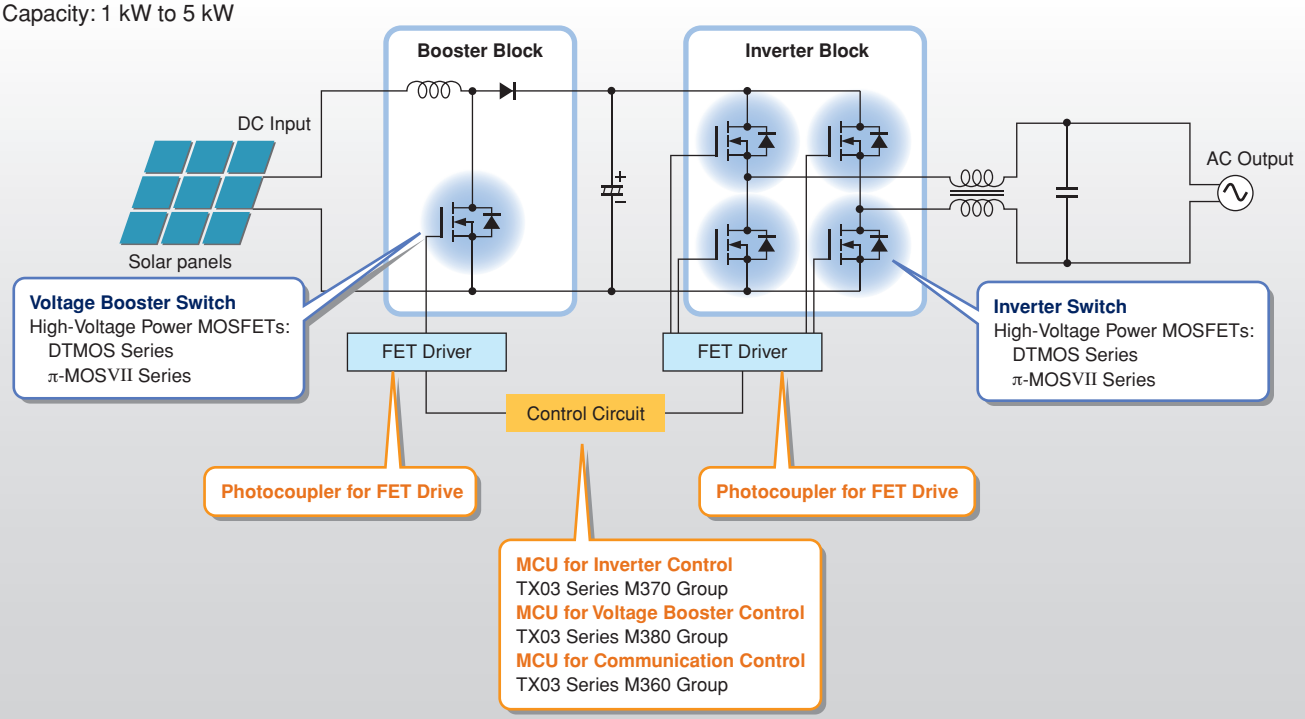
Solar Inverters (Power Conditioning Subsystems (PCS))

Features

- A solar inverter, also known as a power conditioning subsystems (PCS), is a device used to convert DC power generated by solar panels to AC power for use by home appliances. Since the voltage from solar panels varies with sunshine conditions, it is boosted to a constant level first. It is then converted to AC power by using an inverter and then applied to the grid.

Circuit Example

Capacity: 1 kW to 5 kW



Recommended Parts

Output Power (kW)			Up to 1.5	1.5 to 3	3 to 4.5	4.5 to 6
Inverter Switch	High-Voltage Power MOSFETs	150-Vdc Input / 200-Vdc Input	**TK39J60W**** **TK62J60W****			
	IGBT	100-Vac Input / 200-Vac Input	**GT30J341**			
Control Circuit	MCU for Inverter Control		**TMPM370FYDFG, TMPM370FYFG, TMPM372FWUG** **TMPM373FWDUG, TMPM374FWUG** **TMPM376FDDFG, TMPM376FDFG** **TMPM377FYDFG **, TMPM377FYFG ****			
	MCU for Voltage Booster Control		**TMPM380FWFG, TMPM380FWDFG, TMPM380FYFG, TMPM380FYDFG, TMPM380FDFG****			
	MCU for Communication Control		**TMPM369FDFG**, TMPM369FDXBG**, TMPM369FYFG**, TMPM369FYXBG****			
Voltage Booster Switch	High-Voltage Power MOSFETs	Up to 300-Vdc Output / Up to 700-Vdc Output	**TK39J60W**** **TK62J60W****			
	IGBTs	Up to 300-Vdc Output	**GT30J341, GT50JR22****			
FET Drivers	Photocouplers	0.6 to 6.0-A Peak Output	**TLP701H, TLP351H, TLP155E**	**TLP701H, TLP351H, TLP155E**	**TLP700H, TLP352**	**TLP358H**

**: Under development

Switching Power Supplies

DC-DC Converters

DC-DC Converters (Non-Isolated)

Features

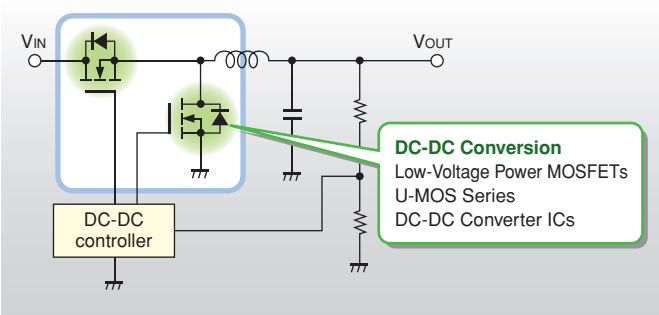
A DC-DC converter converts a direct current from one voltage level to another. While non-isolated DC-DC converters are primarily used for conversion in the 1-W to 30-W range, up to 100 W can be handled by adding a single MOSFET. Many DC-DC converters are deployed in cell phones and mobile devices that are becoming increasingly small, light and feature-rich.

Application Examples

On-board DC-DC converters

- Power supplies for CPUs
- Regulator circuits
- Cell phones

Circuit Example



Recommended Parts

Output Power (W)			Up to 10	10 to 30	30 to 50	50 to 100
DC-DC Conversion	Low-Voltage Power MOSFETs	V_{DSS} = 30 V	TPCC8067-H, TPCC8068-H, TPCC8065-H	TPCA8065-H, TPCA8064-H, TPCA8059-H, TPCA8057-H	TPCA8064-H, TPCA8058-H, TPCA8057-H, TPCA8056-H	TPCA8064-H, TPCA8056-H, TPCA8055-H

Output Current (A)			Up to 1	1 to 3	3 to 5	5 to 6.5
DC-DC Conversion	DC-DC Converter ICs	V_{IN} = 5 V		TCV7104FN, TCV7108FN*, TCV7116FN*, TCV7117F*	TCV7102AF*	TCV7103AF*, TCV7113F*
		V_{IN} = 12 V	TB7109F*	TB7110F*, TB7106F TB7107FN		

*: New products

DC-DC Converters (Isolated)

Features

Isolated DC-DC converters are widely used for applications in which there is a large difference in voltage between the primary and secondary sides of a transformer. Isolated forward converters and isolated full-bridge converters can handle up to 800 W.

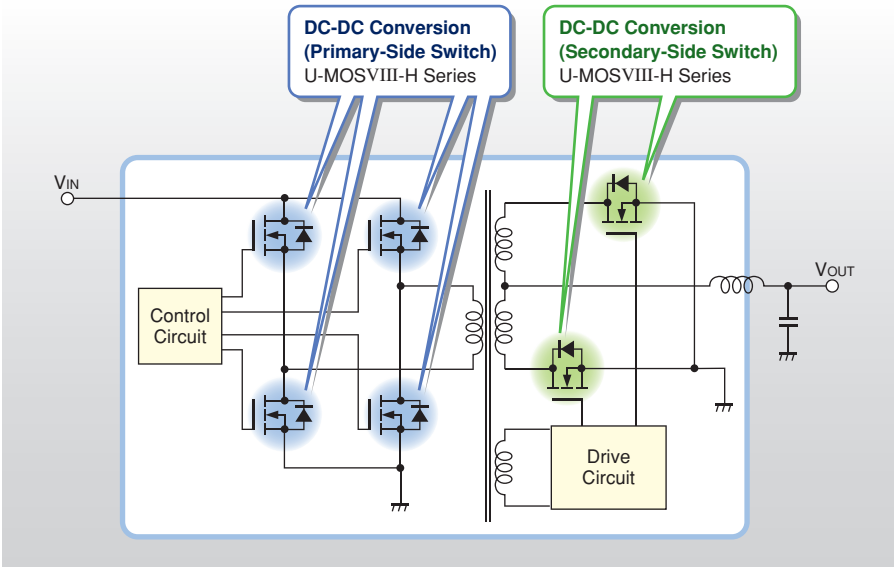
Most PC power supplies use an isolated DC-DC converter.

Application Examples

On-board DC-DC converters

- Notebook PCs
- Power supplies for CPUs
- Regulator circuits
- Communications equipment

Circuit Example (Full-Bridge)



Recommended Parts

Output Power (W)			Up to 100 Forward	Up to 200 Resonant Half-Bridge	Up to 400 Full-Bridge	Up to 800 Full-Bridge
DC-DC Conversion (Primary-Side Switch)	Low-Voltage Power MOSFETs	V_{DSS} = 60 V		TPH7R506NH, TPN7R506NH**, TPH5R906NH, TPH4R606NH	TPN22006NH**, TPH14006NH, TPN14006NH**	TPH7R506NH, TPH5R906NH, TPH4R606NH
		V_{DSS} = 80 V		TPH8R008NH**	TPN30008NH**, TPN13008NH**, TPH12008NH**	TPH8R008NH**
		V_{DSS} = 100 V		TPH8R80ANH**	TPN3300ANH**, TPN1600ANH**, TPH1400ANH**	TPH8R80ANH**
		V_{DSS} = 150 V	TPHxxx0CNH**			
		V_{DSS} = 200 V	TPHxxx0ENH**			
		V_{DSS} = 250 V	TPHxxx0FNH**			
DC-DC Conversion (Secondary-Side Switch)	Low-Voltage Power MOSFETs	V_{DSS} = 60 V	TPN22006NH**, TPH14006NH, TPN14006NH**	TPH14006NH, TPH7R506NH, TPN7R506NH**	TPN22006NH**, TPH14006NH, TPN14006NH**	TPH7R506NH, TPH5R906NH, TPH4R606NH
		V_{DSS} = 80 V	TPN30008NH**, TPN13008NH**, TPH12008NH**	TPN13008NH**, TPH12008NH**, TPH8R008NH**	TPN30008NH**, TPN13008NH**, TPH12008NH**	TPH8R008NH**
		V_{DSS} = 100 V	TPN3300ANH**, TPN1600ANH**, TPH1400ANH**	TPH1400ANH**, TPH8R80ANH**	TPN3300ANH**, TPN1600ANH,** TPH1400ANH**	TPH8R80ANH**

**: Under development

Linear Power Supplies

Features

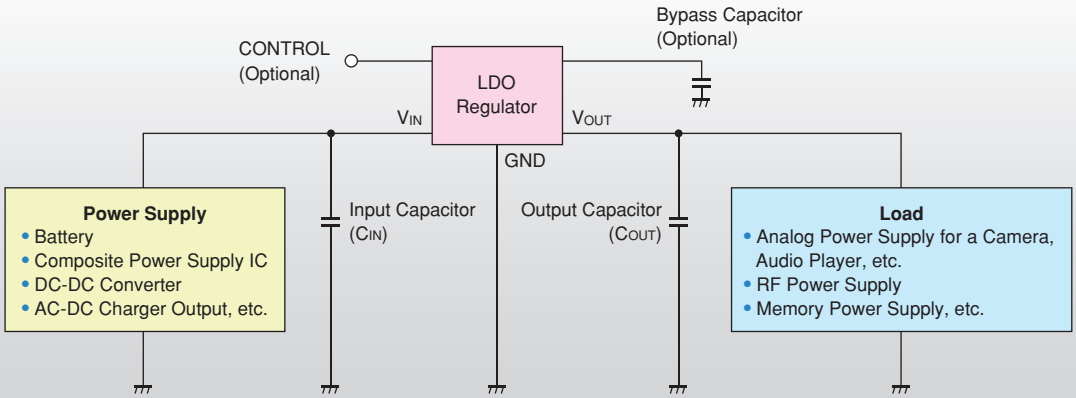
Linear power supplies are available in a wide range of packages from general-purpose SMV (SOT-25) to an ultra-small package with the industry's smallest form factor measuring 0.8 × 0.8 mm. Those in the SDFN4 and WCSP4 packages, which are most widely used for small portable applications, are offered with various current/voltage ratings and additional features.

Application Examples

Small portable devices

- Cell phones
- Portable audio
- Notebook PCs
- Digital still and video cameras

Circuit Example

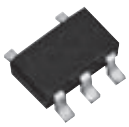
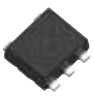
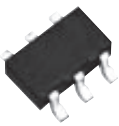


Recommended Parts

Power Supply	Regulator Type	Series	Output	IOUT (mA)	VOUT (V)	Automatic Output Discharge	Package
Linear Power Supplies	LDO Regulators	**TCR2ENxx***	Single	200	1.0 to 3.6	○	SDFN4
		TCR4SxxWBG			1.5 to 3.6		WCSP4
		TCR4SxxDWBG			1.2 to 3.6	○	
		TCR2DGxx**			1.2 to 3.6		
		TCR5SCxxFE		150	1.8 to 3.6		ESV
		TCR2BExx		200	1.0 to 3.6	○	
		TCR2EExx**			1.0 to 3.6	○	
		TAR5SxxU			1.5 to 5.0		UFV
		TCR5SBxxU			1.5 to 5.0		
		TCR5SBxxA		150	1.8 to 5.0		SMV
		TAR5Sxx, TAR5SBxx		200	1.5 to 5.0		
		TCR5SBxx			1.5 to 5.0		
		TCR2BFxx			1.0 to 5.0	○	
		TCR2EFxx**			1.0 to 3.6	○	
		TCR6DAxxxxU	Dual		1.5 to 3.6		UF6
		TCR6DAxxxx			1.5 to 3.6		SM6

*: New products **: Under development

Package

Single-Output					Dual-Output	
SMV SOT-25 (2.8 x 2.9)	UFV (2.0 x 2.1)	ESV SOT-553 (1.6 x 1.6)	WCSP4 (0.79 x 0.79)	SDFN4 (0.8 x 0.8)	SM6 SOT-26 (2.8 x 2.9)	UF6 (2.0 x 2.1)
						

Power Supplies by Application

Wireless Power Transfer

Toshiba is developing LSI for Wireless Power Charger (WPC Conformity).

Features

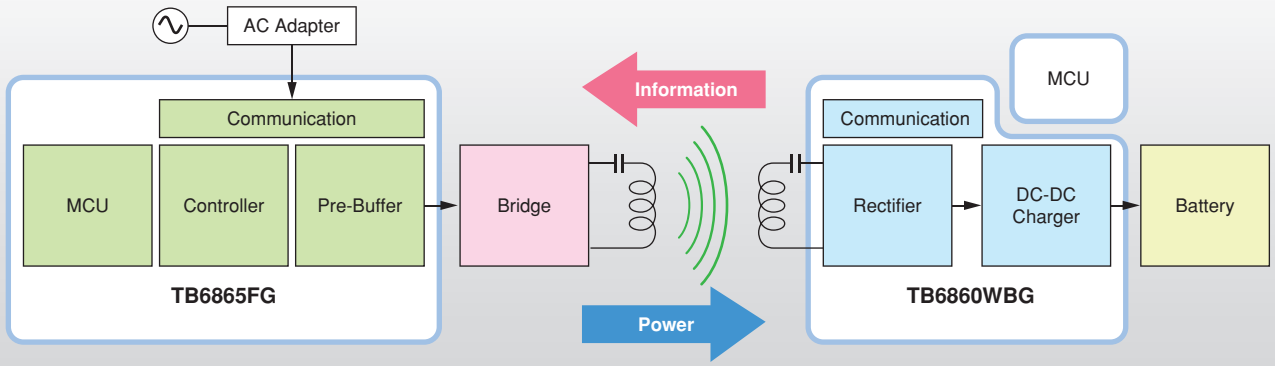
- Features of the TB6865FG (Under development; samples to be available in July, 2012)
  - Cost- and space-saving single-package solution (MCU + analog)
  - Simultaneous charging of up to two devices
  - Position-free (2-coil control architecture)
- Features of the TB6860WBG (Under development; samples to be available in August, 2012)
  - High-current output due to the use of a switching DC-DC converter (maximum output: 950 mA)
  - Various charge control sequences (Programmable via an I^2C bus)
  - Fail-safe detection for input voltage, output current and die temperature

Application Examples

- Smartphones, digital still cameras, other portable devices

Power-Receiving Jacket (for Smartphones)　　Transmitter Pad

System Block Diagram



Recommended Parts

Wireless Power Transfer ICs

Part Number	Applications	Features	Operating Input Voltage (V)	Output Current Max(A)	Switching Frequency (MHz)	Package
TB6860WBG**	Receiver IC	Sync. rectifier, DC-DC converter, LDO regulator for MCU (3.3 V)	3.4 to 15.0	1.2	3.0	WCSP39
TB6865FG**	Transmitter IC	MCU, pre-buffer, simultaneous charging of two devices	Analog(Pre Driver) 4.5 to 15.0 Digital 2.7 to 3.6	—	—	LQFP100

**: Under development

Low-Voltage Power MOSFETs for Bridge Applications

Part Number	Applications	Polarity	V_{DSS}(V)	V_{GSS}(V)	I_D(A)	$R_{DS(ON)}$ Max(mΩ)	Package
SSM6K504NU*	MOSFET for bridge applications	N-ch	30	±20	9	26	UDFN6
SSM6N55NU*	MOSFET for bridge applications	N-ch x 2	30	±20	4	64	UDFN6
SSM6P49NU*	MOSFET for bridge applications	P-ch x 2	30	±12	–4	56	UDFN6

*: New products

Rechargeable Lithium-Ion Batteries

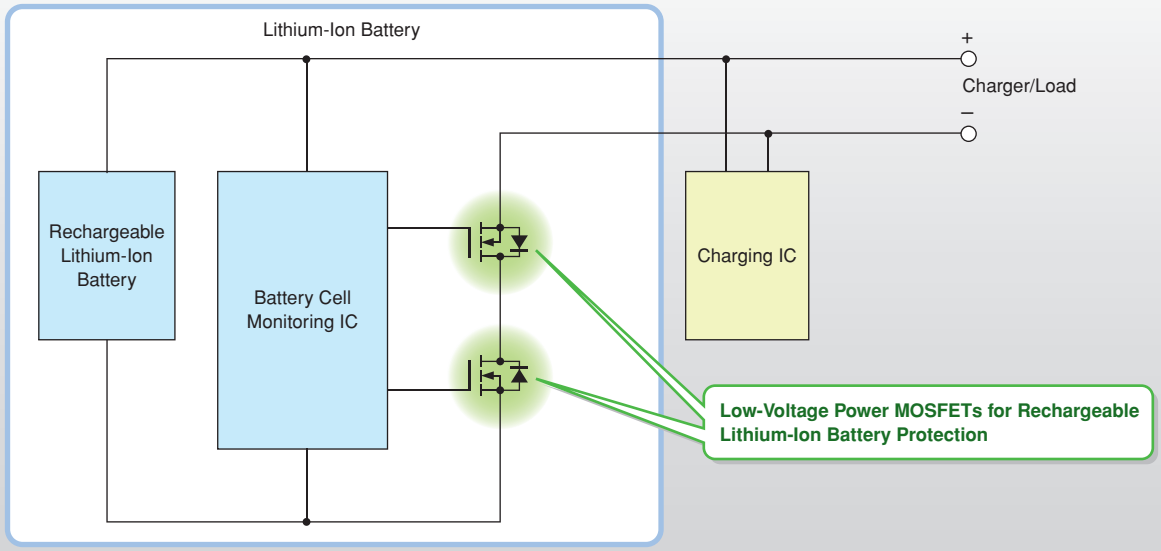
Features

Shown below is a design technique for protecting a rechargeable lithium-ion battery from overcharge, overdischarge and overcurrent.

Application Examples

- Notebook PCs
- Portable devices

Circuit Example



Recommended Parts

Number of Series Cells	Applications	Type	Part Number	Package
1-cell	Smartphones, cell phones	Low-Voltage Power MOSFETs (Chip LGA Series)	**TPCL4201 TPCL4202 TPCL4203**	Chip LGA
		Charging IC	**TC7710WBG****	WCSP25
1- to 2-cell	Tablet PCs	Low-Voltage Power MOSFETs (U-MOSVII Series)	**TPCP8206 TPCC8093**	PS-8 TSON Advance
3- to 4-cell	Notebook PCs	Low-Voltage Power MOSFETs (U-MOSVIII Series)	**TPN2R503NC** TPN4R203NC****	TSON Advance
5-cell or greater	Bicycles, UPS, etc.	Low-Voltage Power MOSFETs (U-MOSVIII Series)	**TK100G06N1** TK100G08N1** TK100G10N1****	TO-220SM

**: Under development

PFC Control ICs

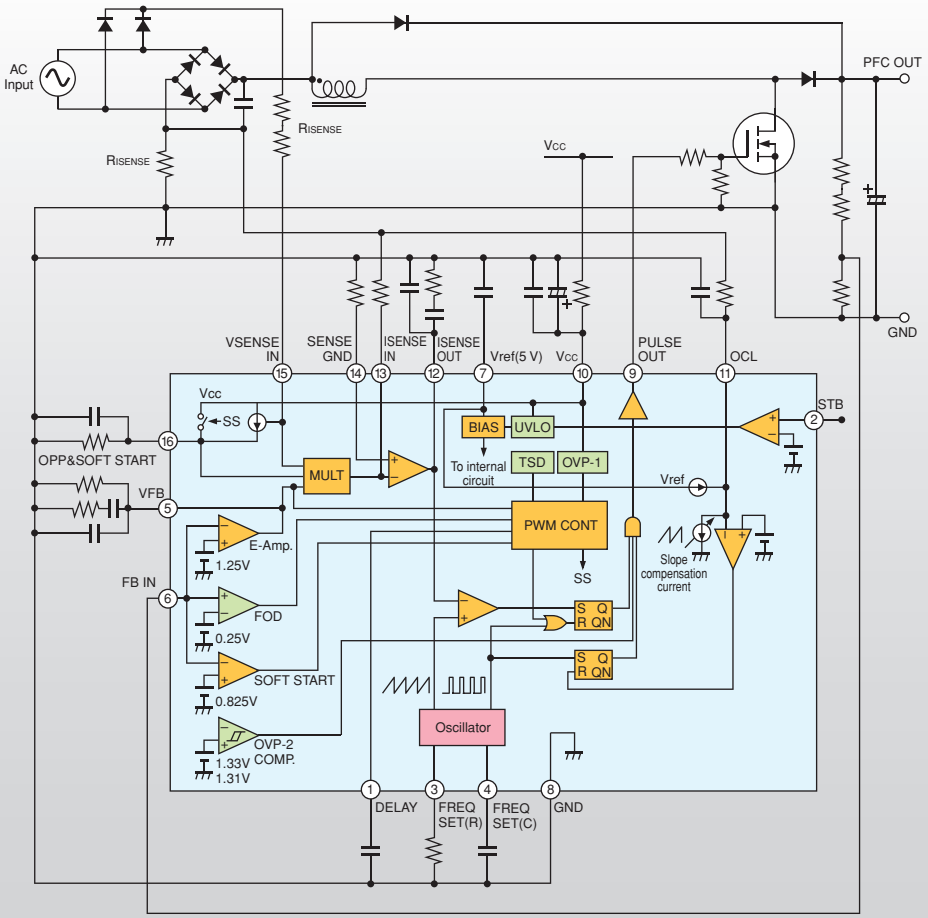
Toshiba has been developing power factor correction (PFC) controllers for reducing power factor degradation (or an increase in reactive power) and noise on AC mains due to harmonics current.

TB6818FG

Features

- Operating voltage range: 8.4 V (min) to 26 V (max)
- Startup voltage: 10.0 V (typ.)
- Pulse output mute function (starting)
- Avoiding PFC transformer noise
- Maximum drive current: 1.0 A (typ.)
- Consumption current: 250 μA (typ.)(Standby mode)
- AC instantaneously-stop detection
- Built-in protection circuits
  - DC input overvoltage protection (OVP-1)
  - PFC output overvoltage protection (OVP-2)
  - Undervoltage lockout (UVLO)
  - Feedback-loop open detection (FOD)
  - Thermal shutdown (TSD)

Block Diagram



Product Lineup

Part Number	Conduction	Supply Voltage (V)	Package	Status
TB6818FG	CCM	8.4 to 26	SSOP16	Available
TB6819AFG	CRM	9.5 to 25	SOP8	Available

Power MOSFETs for PFC Control and Switching Applications

π-MOSVII Series

The latest addition to the π-MOS portfolio, the π-MOSVII Series offers reduced capacitances due to optimized chip design and is available with a greatly wider range of electrical characteristics.

Features

- 40% reduction in Q_g from π-MOSVI due to optimized chip design
- Available in 50-V steps of V_{DSS} and in finer steps of $R_{DS(ON)}$.
- Rated avalanche and reverse recovery current capabilities

Product Lineup

Part Number	Absolute Maximum Ratings		$R_{DS(ON)}$ Max(Ω)	Qg Typ.	Package
	V_{DSS} (V)	I_D (A)	V_{GS} = 10 V	(nC)	
TK5A45DA	450	4.5	1.75	9	TO-220SIS
TK6A45DA		5.5	1.35	11	TO-220SIS
TK7A45DA		6.5	1.2	11	TO-220SIS
TK8A45DA		7.5	1.1	12	TO-220SIS
TK8A45D		8	0.9	14	TO-220SIS
TK9A45D		9	0.77	16	TO-220SIS
TK11A45D		11	0.62	20	TO-220SIS
TK12A45D		12	0.52	24	TO-220SIS
TK13A45D		13	0.46	25	TO-220SIS
TK14A45DA		13.5	0.41	28	TO-220SIS
TK14A45D		14	0.34	38	TO-220SIS
TK16A45D		16	0.27	40	TO-220SIS
TK19A45D		19	0.25	50	TO-220SIS
TK3P50D	500	3	3	7	DPAK
TK4A50D		4	2	9	TO-220SIS
TK4P50D		4	2	9	DPAK
TK5A50D		5	1.5	11	TO-220SIS
TK5P50D		5	1.5	11	DPAK
TK6A50D		6	1.4	11	TO-220SIS
TK7A50D		7	1.22	12	TO-220SIS
TK7P50D		7	1.22	12	DPAK
TK8A50DA		7.5	1.04	16	TO-220SIS
TK8A50D		8	0.85	16	TO-220SIS
TK10A50D		10	0.72	20	TO-220SIS
TK11A50D		11	0.6	38	TO-220SIS
TK12A50D		12	0.52	25	TO-220SIS
TK13A50DA		12.5	0.47	28	TO-220SIS
TK13A50D		13	0.4	38	TO-220SIS
TK15A50D		15	0.3	40	TO-220SIS
TK15J50D		15	0.4	38	TO-3P(N)
TK18A50D		18	0.27	45	TO-220SIS
TK20J50D		20	0.27	45	TO-3P(N)

Part Number	Absolute Maximum Ratings		$R_{DS(ON)}$ Max(Ω)	Qg Typ.	Package
	V_{DSS} (V)	I_D (A)	V_{GS} = 10 V	(nC)	
TK2P60D	600	2	4.3	7	New PW-Mold
TK2Q60D		2	4.3	7	New PW-Mold2
TK3A60DA		2.5	2.8	9	TO-220SIS
TK4A60DA		3.5	2.2	11	TO-220SIS
TK4P60DA		3.5	2.2	11	DPAK
TK4A60DB		3.7	2.2	11	TO-220SIS
TK4P60DB		3.7	2	11	DPAK
TK4A60D		4	1.7	12	TO-220SIS
TK5A60D		5	1.43	16	TO-220SIS
TK6A60D		6	1.25	16	TO-220SIS
TK8A60DA		7.5	1	20	TO-220SIS
TK9A60D		9	0.83	24	TO-220SIS
TK10A60D		10	0.75	25	TO-220SIS
TK11A60D		11	0.65	28	TO-220SIS
TK12A60D		12	0.55	38	TO-220SIS
TK13A60D		13	0.43	40	TO-220SIS
TK15A60D		15	0.37	45	TO-220SIS
TK2A65D	650	2	3.26	9	TO-220SIS
TK3A65DA		2.5	2.51	11	TO-220SIS
TK3A65D		3	2.25	11	TO-220SIS
TK4A65DA		3.5	1.9	12	TO-220SIS
TK5A65DA		4.5	1.67	16	TO-220SIS
TK5A65D		5	1.5	16	TO-220SIS
TK6A65D		6	1.11	20	TO-220SIS
TK7A65D		7	0.98	24	TO-220SIS
TK8A65D		8	0.84	25	TO-220SIS
TK11A65D		11	0.7	30	TO-220SIS
TK12A65D		12	0.54	40	TO-220SIS
TK13A65D		13	0.47	45	TO-220SIS

DTMOSIV Series (Under development)

The DTMOS devices employ a super-junction structure that enables an ultra-low on-resistance with the maximum V_{DSS} rating of 600 V.

Features

Reduced $R_{DS(ON)}$ due to the Use of Super-Junction Technology

Compared to the π-MOS Series, the DTMOS Series is characterized by the use of a super-junction structure to greatly reduce $R_{DS(ON)}$. Additionally, the latest DTMOSIV provides an approximately 40% reduction in $R_{DS(ON)}$ over DTMOSI, making it possible to house a MOSFET with $R_{DS(ON)}$ of less than 100 mΩ in the TO-220SIS package. This leads to increases in power efficiency and power density.

Product Lineup

Part Number	Absolute Maximum Ratings		$R_{DS(ON)}$ Max(Ω)	Qg Typ.	Package
	V_{DSS} (V)	I_D (A)	V_{GS} = 10 V	(nC)	
TK5A60W	600	5.4	0.9	8.5	TO-220SIS
TK5P60W		5.4	0.9	8.5	DPAK
TK5Q60W		5.4	0.9	8.5	IPAK
TK6A60W		6.2	0.75	12	TO-220SIS
TK6P60W		6.2	0.75	12	DPAK
TK6Q60W		6.2	0.75	12	IPAK
TK7A60W		7	0.6	13	TO-220SIS
TK7P60W		7	0.6	13	DPAK
TK7Q60W		7	0.6	13	IPAK
TK8A60W		8	0.5	16	TO-220SIS
TK8P60W		8	0.5	16	DPAK
TK8Q60W		8	0.5	16	IPAK
TK10A60W		9.7	0.38	20	TO-220SIS
TK10P60W		9.7	0.38	20	DPAK
TK10Q60W		9.7	0.38	20	IPAK
TK10E60W		9.7	0.38	20	TO-220

Part Number	Absolute Maximum Ratings		$R_{DS(ON)}$ Max(Ω)	Qg Typ.	Package
	V_{DSS} (V)	I_D (A)	V_{GS} = 10 V	(nC)	
TK12A60W	600	11.5	0.3	25	TO-220SIS
TK12P60W		11.5	0.3	25	DPAK
TK12Q60W		11.5	0.3	25	IPAK
TK12E60W		11.5	0.3	25	TO-220
TK12J60W		11.5	0.3	25	TO-3P(N)
TK16A60W		15.8	0.19	38	TO-220SIS
TK16E60W		15.8	0.19	38	TO-220
TK16J60W		15.8	0.19	38	TO-3P(N)
TK31A60W		30.8	0.088	87	TO-220SIS
TK31E60W		30.8	0.088	87	TO-220
TK31J60W		30.8	0.088	87	TO-3P(N)
TK39A60W		38.8	0.065	110	TO-220SIS
TK39J60W		38.8	0.065	110	TO-3P(N)
TK62J60W		61.8	0.04	178	TO-3P(N)

Product Overview:
Devices for AC-DC Power Supply Applications

Switching Power Transistors

Product Lineup

Package	Part Number	Absolute Maximum Ratings			DC Characteristics						Switching Characteristics		
		V_{CBO} (V)	V_{CEO} (V)	I_C (A)	h_{FE} Min	V_{CE} (V)	I_C (A)	$V_{CE(sat)}$ Max (V)	I_C (A)	I_B (A)	t_r Max (μs)	t_{stg} Max (μs)	t_f Max (μs)
PW-Mold	**2SC5548A**	600	400	2	40	5	0.2	1.0	0.8	0.1	0.5	3.0	0.3
	TTC008	600	285	1.5	100	5	0.3	1.0	0.5	0.0625	0.05(typ.)	3.3(typ.)	0.1(typ.)
	2SC6142	800	375	1.5	100	5	0.1	0.9	0.8	0.1	0.2(typ.)	3.5(typ.)	0.15(typ.)
	TTC012	800	375	2	100	5	0.3	0.5	0.5	0.0625	0.1(typ.)	4.4(typ.)	0.15(typ.)

Power Transistors for MOS Gate Drivers (for High-Speed Gate Drive of MOS Devices)

Product Lineup (2-in-1 Series)

Package	Part Number	Polarity	Absolute Maximum Ratings				h_{FE}				$V_{CE(sat)}$ Max		
			V_{CEO} (V)	I_C (A)	I_{CP} (A)	P_C (mW)	Min	Max	V_{CE} (V)	I_C (A)	(V)	I_C (A)	I_B (mA)
SMV	**HN4B101J**	PNP	–30	–1.0	–5	550	200	500	–2	–0.12	–0.2	–0.4	–13
		NPN	30	1.2	5	550	200	500	2	0.12	0.17	0.4	13
	HN4B102J	PNP	–30	–1.8	–8	750	200	500	–2	–0.2	–0.2	–0.6	–20
		NPN	30	2	8	750	200	500	2	0.2	0.14	0.6	20
VS-6	**TPC6901A**	PNP	–50	–0.7	–5	400	200	500	–2	–0.1	–0.23	–0.3	–10
		NPN	50	1	5	400	400	1000	2	0.1	0.17	0.3	6
	TPC6902	PNP	–30	–1.7	–8	700	200	500	–2	–0.2	–0.2	–0.6	–20
		NPN	30	2	8	700	200	500	2	0.2	0.14	0.6	20
PS-8	**TPCP8901**	PNP	–50	–0.8	–5	830	200	500	–2	–0.1	–0.2	–0.3	–10
		NPN	50	1	5	830	400	1000	2	0.1	0.17	0.3	6
	TPCP8902	PNP	–30	–2	–8	890	200	500	–2	–0.2	–0.2	–0.6	–20
		NPN	30	2	8	890	200	500	2	0.2	0.14	0.6	20

Transistor-Output Photocouplers

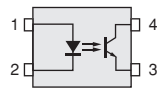
TLP185/TLP291

The TLP185 and TLP291 are new additions to Toshiba's transistor-output photocoupler offerings in a small, thin package that is compliant with the reinforced insulation class of international safety standards.

The TLP185 and TLP291 have achieved certification for a safety level higher than the previous devices by providing a creepage/clearance distance of more than 5 mm; insulation thickness of more than 0.4 mm; and thus the isolation voltage of more than 3750 Vrms.

- VDE-approved: EN60747-5-5-approved with option V4
  Maximum working insulation voltage: 707 Vpk
  Maximum transient overvoltage: 6000 Vpk
- UL-recognized: UL1577 (File No. E67349)
- BSI approved
- Creepage/clearance: 5.0 mm (min)
- Insulation thickness: 0.4 mm (min)
- Operating temperature: Ta = –55˚C to 110˚C

Pin Configuration



1: Anode
2: Cathode
3: Emitter
4: Corrector

Product Lineup
(Photocouplers with transistor output providing isolated feedback from the secondary side to the primary side)

Part Number	Package	Absolute Maximum Ratings (Ta=25˚C)				Safety Standards			
		IF (mA)	V_{CEO} (V)	I_C (mA)	Isolation voltage (Vrms)	UL cUL	VDE EN60747-5-5*	BSI EN60950 EN60065	SEMKO EN60950 EN60065
TLP185	SO6 (4pin)	50	80	50	3750	○	○	○	○
TLP291	SO4	50	80	50	3750	○	○	○	○
TLP785	DIP4	50	80	50	5000	○	○**	○	○

*The EN60747-5-5 approvals vary with packages. For details, please contact our sales representative.
**TLP785 acquired EN60747-5-2 approval.

Schottky Barrier Diodes (SBDs) and High-Efficiency Diodes (HEDs)

Product Lineup

Schottky Barrier Diodes (SBDs)

Package	Part Number	Absolute Maximum Ratings					Electrical Characteristics (Max)				
		V_{RRM} (V)	$I_{F(AV)}$ (A)	I_{FSM} (A)	T_j (°C)	T_{stg} (°C)	I_{RRM} (mA)	V_{FM} (V)	@I_{FM} (A)	C_j (pF)(Typ.)	Conditions
US-FLAT™	CUS05	20	1.0	20	125	–40 to 150	1.0	0.37	0.7	40	V_R = 10 V, f = 1 MHz
	CUS06			20	150	–40 to 150	0.03	0.45	0.7	40	
	CUS01	30		20	125	–40 to 150	1.5	0.37	0.7	40	
	CUS02			20	150	–40 to 150	0.1	0.45	0.7	40	
	CUS10I30A			20	150	–55 to 150	0.06	0.39	0.7	50	
	CUS15I30A			20	150	–55 to 150	0.06	0.46	1.5	50	
	CUS03	40	0.7	20	150	–40 to 150	0.1	0.52	0.7	45	
	CUS10I40A		1.0	20	150	–55 to 150	0.06	0.49	0.7	35	
	CUS04	60	0.7	20	150	–40 to 150	0.1	0.58	0.7	38	
S-FLAT™	CRS06	20	1.0	20	125	–40 to 150	1	0.36	1.0	60	V_R = 10 V, f = 1 MHz
	CRS01	30		20	125	–40 to 150	1.5	0.37	0.7	40	
	CRS03			20	150	–40 to 150	0.1	0.45	0.7	40	
	CRS05			20	150	–40 to 150	▽	0.45	1.0	60	
	CRS11			20	125	–40 to 150	1.5	0.36	1.0	60	
	CRS10I30A			20	150	–55 to 150	0.06	0.39	0.7	50	
	CRS10I30B			20	150	–55 to 150	0.06	0.42	1.0	50	
	CRS10I30C			30	150	–55 to 150	0.10	0.36	1.0	82	
	CRS08		1.5	30	125	–40 to 150	1	0.36	1.5	90	
	CRS09			30	150	–40 to 150	0.05	0.46	1.5	90	
	CRS15I30A			20	150	–55 to 150	0.06	0.46	1.5	50	
	CRS15I30B			30	150	–55 to 150	0.10	0.40	1.5	82	
	CRS14		2.0	30	150	–40 to 150	0.05	0.49	2	90	
	CRS20I30A			20	150	–55 to 150	0.06	0.49	2.0	50	
	CRS20I30B			30	150	–55 to 150	0.10	0.45	2.0	82	
	CRS15 ◇		3.0	30	150	–40 to 150	0.05	0.52	3.0	90	
	CRS30I30A			30	150	–55 to 150	0.10	0.49	3.0	82	
	CRS04	40	1.0	20	150	–40 to 150	0.1	0.49	0.7	47	
	CRS10I40A			20	150	–55 to 150	0.06	0.49	0.7	35	
	CRS10I40B			25	150	–55 to 150	0.10	0.45	1.0	62	
	CRS15I40A			20	150	–55 to 150	0.06	0.55	1.5	35	
	CRS20I40A			20	150	–55 to 150	0.06	0.60	2.0	35	
	CRS20I40B			25	150	–55 to 150	0.10	0.52	2.0	62	
	CRS12	60	1.0	20	150	–40 to 150	0.1	0.58	1.0	40	
	CRS13			20	150	–40 to 150	0.05	0.55	1.0	40	
M-FLAT™	CMS08	30	1.0	25	125	–40 to 150	1.5	0.37	1.0	70	V_R = 10 V, f = 1 MHz
	CMS09			25	150	–40 to 150	0.5	0.45	1.0	70	
	CMS10I30A			30	125	–55 to 150	0.10	0.36	1.0	82	
	CMS06		2.0	40	125	–40 to 150	3.0	0.37	2.0	130	
	CMS07			40	150	–40 to 150	0.5	0.45	2.0	130	
	CMS17			30	150	–40 to 150	0.1	0.48	2.0	90	
	CMS20I30A			30	150	–55 to 150	0.10	0.45	2.0	82	
	CMS01		3.0	40	125	–40 to 150	5.0	0.37	3.0	190	
	CMS03			40	150	–40 to 150	0.5	0.45	3.0	190	
	CMS30I30A			30	150	–55 to 150	0.10	0.49	3.0	82	
	CMS04		5.0	70	125	–40 to 150	8.0	0.37	5.0	330	
	CMS05			70	150	–40 to 150	0.8	0.45	5.0	330	
	CMS10	40	1.0	25	150	–40 to 150	0.5	0.55	1.0	50	
	CMS10I40A			25	150	–55 to 150	0.10	0.45	1.0	62	
	CMS15I40A			25	150	–55 to 150	0.10	0.49	1.5	62	
	CMS11		2.0	30	150	–40 to 150	0.5	0.55	2.0	95	
	CMS20I40A			25	150	–55 to 150	0.10	0.52	2.0	62	
	CMS16		3.0	30	150	–40 to 150	0.2	0.55	3.0	95	
	CMS30I40A			25	150	–55 to 150	0.10	0.55	3.0	62	
	CMS14	60	2.0	40	150	–40 to 150	0.2	0.58	2.0	77	
	CMS15		3.0	60	150	–40 to 150	0.3	0.58	3.0	102	
L-FLAT™	CLS01	30	10	100	125	–40 to 150	1.0	0.47	10	530	V_R = 10 V, f = 1 MHz
	CLS02	40		100	125	–40 to 150	1.0	0.55	10	420	
	CLS03	60		100	125	–40 to 150	1.0	0.58	10	345	

▽: I_{RRM} = 5 μA Max (V_R = 5 V) ◇: $I_{F(DC)}$ = 3 A

High-Efficiency Diodes (HEDs)

Package	Part Number	Absolute Maximum Ratings					Electrical Characteristics (Max)				
		V_{RRM} (V)	$I_{F(AV)}$ (A)	I_{FSM} (A)	T_j (°C)	T_{stg} (°C)	I_{RRM} (μA)	V_{FM} (V)	@I_{FM} (A)	trr(ns)	Conditions
S-FLAT™	CRH02	200	0.5	10	150	–40 to 150	10	0.95	0.5	35	I_F = 1 A, di/dt = –30 A/μs
	CRH01	200	1.0	15	150	–40 to 150	10	0.98	1.0	35	
M-FLAT™	CMH04	200	1.0	20	150	–40 to 150	10	0.98	1.0	35	I_F = 1 A, di/dt = –30 A/μs
	CMH07	200	2.0	40	150	–40 to 150	10	0.98	2.0	35	
	CMH01	200	3.0	40	150	–40 to 150	10	0.98	3.0	35	
	CMH05	400	1.0	20	150	–40 to 150	10	1.3	1.0	50	
	CMH05A	400	1.0	10	150	–40 to 150	10	1.8	1.0	35	
	CMH08	400	2.0	30	150	–40 to 150	10	1.3	2.0	50	
	CMH08A	400	2.0	20	150	–40 to 150	10	1.8	2.0	35	
	CMH02	400	3.0	40	150	–40 to 150	10	1.3	3.0	50	
	CMH02A	400	3.0	30	150	–40 to 150	10	1.8	3.0	35	
L-FLAT™	CLH01	200	3.0	60	150	–40 to 150	10	0.98	3.0	35	I_F = 2 A, di/dt = –50 A/μs
	CLH05	200	5.0	100	150	–40 to 150	10	0.98	5.0	35	
	CLH02	300	3.0	50	150	–40 to 150	10	1.3	3.0	35	
	CLH06	300	5.0	60	150	–40 to 150	10	1.3	5.0	35	
	CLH03	400	3.0	30	150	–40 to 150	10	1.8	3.0	35	
	CLH07	400	5.0	50	150	–40 to 150	10	1.8	5.0	35	

Product Overview:
Devices for AC-DC Power Supply Applications

Synchronous Rectification MOSFETs

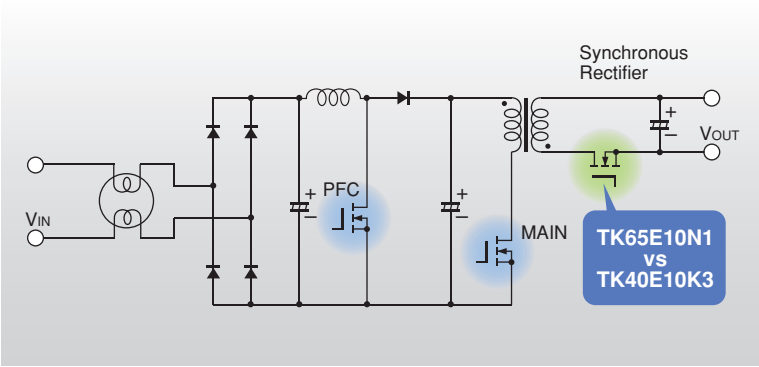
U-MOSVIII-H Series (V_{DSS} = 60 to 120 V)

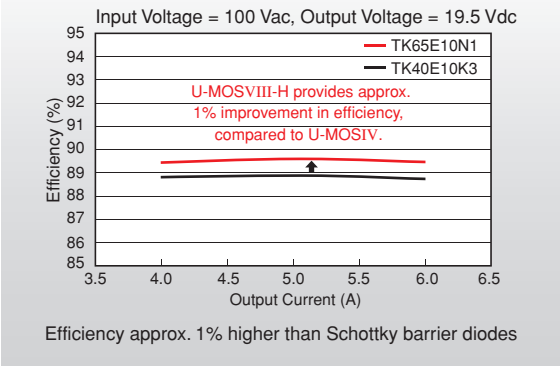
Features

- Low on-resistance achieved by high density through the use of submicron technology
- Guaranteed avalanche capability

Efficiency Test Circuit

120 W (19.5 V/6.2 A) Flyback Converter
V_{IN} = 100 Vac





Efficiency approx. 1% higher than Schottky barrier diodes

Product Lineup

Part Number	Absolute Maximum Ratings				$R_{DS(ON)}$ (mΩ) @V_{GS} = 10 V		Qg (nC) Typ.	Q_{sw} (nC) Typ.	Package	Series
	V_{DSS} (V)	V_{GSS} (V)	I_D (A)	P_D (W)	Typ.	Max	V_{DD} = V_{DSS} x 0.8, I_D = $I_{D(DC)}$			
TK75A06K3	60	±20	75	35	4.5	5.5	85	—	TO-220SIS	U-MOSIV
TK46E08N1	80	±20	80	103	6.9	8.4	37	16	TO-220	U-MOSVIII-H
TK46A08N1	80	±20	80	35	6.9	8.4	37	16	TO-220SIS	U-MOSVIII-H
TK72E08N1	80	±20	157	192	3.6	4.3	81	33	TO-220	U-MOSVIII-H
TK72A08N1	80	±20	157	45	3.7	4.5	81	33	TO-220SIS	U-MOSVIII-H
TK100E08N1	80	±20	214	255	2.6	3.2	130	53	TO-220	U-MOSVIII-H
TK100A08N1	80	±20	214	45	2.6	3.2	130	53	TO-220SIS	U-MOSVIII-H
TK100G08N1**	80	±20	(224)	250	(2.3)	(2.8)	TBD	TBD	TO-220SM	U-MOSVIII-H
TK18E10K3	100	±20	18	71	33	42	33	—	TO-220	U-MOSIV
TK22E10N1	100	±20	52	72	11.5	13.8	28	12	TO-220	U-MOSVIII-H
TK22A10N1	100	±20	52	30	11.5	13.8	28	12	TO-220SIS	U-MOSVIII-H
TK34E10N1	100	±20	75	103	7.9	9.5	38	15	TO-220	U-MOSVIII-H
TK34A10N1	100	±20	75	35	7.9	9.5	38	15	TO-220SIS	U-MOSVIII-H
TK40E10N1	100	±20	90	126	6.8	8.2	49	21	TO-220	U-MOSVIII-H
TK40A10N1	100	±20	90	35	6.8	8.2	49	21	TO-220SIS	U-MOSVIII-H
TK65E10N1	100	±20	148	192	4	4.8	81	32	TO-220	U-MOSVIII-H
TK65A10N1	100	±20	148	45	4	4.8	81	32	TO-220SIS	U-MOSVIII-H
TK65G10N1**	100	±20	(151)	192	(3.7)	(4.5)	81	32	TO-220SM	U-MOSVIII-H
TK100E10N1	100	±20	207	255	2.8	3.4	140	55	TO-220	U-MOSVIII-H
TK100A10N1	100	±20	207	45	3.1	3.8	140	55	TO-220SIS	U-MOSVIII-H
TK100G10N1**	100	±20	(212)	250	(2.6)	(3.1)	TBD	TBD	TO-220SM	U-MOSVIII-H
TK56E12N1**	120	±20	112	168	5.8	7.0	69	29	TO-220	U-MOSVIII-H
TK56A12N1**	120	±20	112	45	6.2	7.5	69	29	TO-220SIS	U-MOSVIII-H

**: Under development(All specs are preliminary.)

Product Overview:
Devices for DC-DC Converter Applications

Single-Output Buck DC-DC Converter ICs

These DC-DC converter ICs are best suited to low-voltage, high-current drive of ICs implemented in various equipment, such as SoCs and ASICs.
Toshiba's DC-DC converter ICs require only a few external components, such as inductors, capacitors and output voltage setting resistors. They help to reduce the size and improve the efficiency (i.e., reduce the power loss) of various applications.

Features

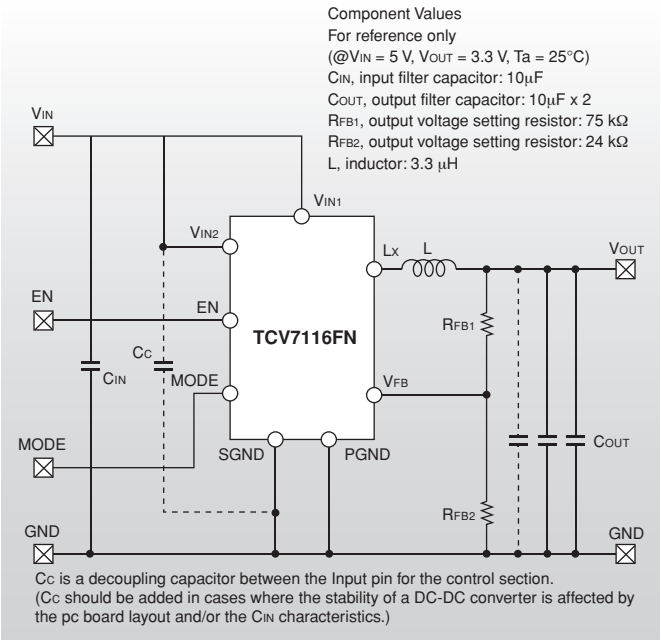
- Available with output current capabilities ranging from 0.5 A to 6.5 A.
- High efficiency: 95% typical when the TCV7116FN is used @ V_{IN} = 5 V, V_{OUT} = 3.3 V, I_{OUT} = 0.7 A, PWM mode
- Improved efficiency at light loads: TCV7106FN/07F/13F/16FN/17F
- Dual-output DC-DC converters with series regulator: TB7109F/10F
- High accuracy reference voltage (V_{FB}): 0.8 V ± 1% (with the TCV71xx series)
- Reduces the size of external parts by offering the high-frequency switching ability.
- Offers fast transient response using current-mode control.
- A ceramic capacitor can be used as an output filter capacitor.

Application Examples

- LCD TVs
- Digital home appliances
- Plasma TVs
- Amusement equipment
- Copies
- Industrial equipment

Application Circuit Example (TCV7116FN)

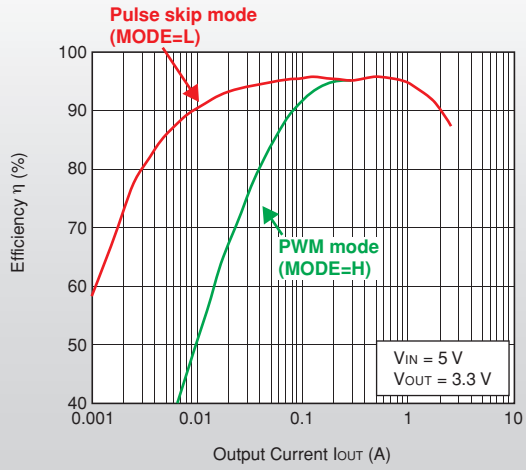
Here is a typical application circuit using a low-ESR electrolytic capacitor or a ceramic capacitor as C_{OUT}.



CC is a decoupling capacitor between the Input pin for the control section.
(CC should be added in cases where the stability of a DC-DC converter is affected by the pc board layout and/or the CIN characteristics.)

Efficiency Curves<Typical Characteristics> (TCV7116FN)

The integrated high-speed, low-Ron MOSFETs allow the switching between Continuous PWM mode and Pulse Skip mode according to the voltage at the MODE pin. This feature provides high efficiency over a wide output current range.



Product Lineup

Part Number	Output Current (A)	Operating Input Voltage (V)	Output Voltage (V)	Switching Frequency (kHz)	Functions			Package	Remarks
					Synchronous Rectification	External Low-Side MOS	Phase Compensation Logic		
TCV7103AF	6.5	2.7 to 5.6	Adjustable (V_{FB} = 0.8 ± 1%)	1000	●	●	Integrated	SOP Advance	
TCV7113F		2.7 to 5.6		1000	Chopper mode avail*1	●	Integrated	SOP Advance	Improved light-load efficiency
TCV7101F	3.8	2.7 to 5.5		600	●	●	Integrated	SOP Advance	
TCV7102AF		2.7 to 5.6		1400	●		Integrated	SOP Advance	
TCV7107F	3.0	2.7 to 5.6		550	Chopper mode avail		Integrated	SOP Advance	Improved light-load efficiency
TCV7117F		2.7 to 5.6		550	●		Integrated	SOP Advance	Improved light-load efficiency
TCV7100AF	2.7	2.7 to 5.5		800	●		Integrated	SOP Advance	
TCV7105F	2.5	2.7 to 5.5		1500	●		Integrated	SOP Advance	
TCV7106FN		2.7 to 5.6		550	Chopper mode avail		Integrated	PS-8	Improved light-load efficiency
TCV7116FN		2.7 to 5.6		550	●		Integrated	PS-8	Improved light-load efficiency
TCV7108FN		2.7 to 5.6		1500	●		Integrated	PS-8	Improved load transient response
TCV7104FN	2.0	2.7 to 5.5		1500	●		Integrated	PS-8	
TB7106F	3.0	4.5 to 20	Adjustable (V_{FB} = 0.8 ± 2.25%)	380			Externally required	SOP Advance	
TB7107FN	2.0	4.5 to 20		380			Externally required	PS-8	
TB7110F	1.5	4.5 to 27	Adjustable (V_{FB} = 1.215 ± 2.9%)	500			Integrated	SOP Advance	DC-DC conv. + regulator
TB7109F	0.5	8 to 27		400			Integrated	SOP Advance	DC-DC conv. + regulator (for LNB)

*1: Automatic switchable operation type.

Product Overview:
Devices for DC-DC Converter Applications

Multiple-Output DC-DC Converter ICs

Features

Multiple-output DC-DC converter ICs are power management ICs (PMICs) that integrate several DC-DC converters on a single chip for space-saving applications. One PMIC can supply power to multiple peripheral devices and meet the needs for various applications. Multiple-output DC-DC converters are available with various output channel options to meet diverse requirements.

Application Examples

- Cell phones
- Digital still cameras

Product Lineup

Part Number	Application	Channels					Operating Input Voltage (V)	Switching Frequency (kHz)	Package
		Boost	Buck	Buck-Boost	Invert	LDO			
TB6817WBG	SSD	–	2	–	–	–	3.0 to 3.6	1500	WCSP24
TB6830WBG	WiMAX	–	2	1	–	5	2.7 to 5.5	1500	WCSP53
TC7731FTG **	DDR2/3	–	1	–	–	1	2.7 to 5.5	500/1000	QFN40
TC7732FTG **	Cell phones	–	1	–	–	4	2.5 to 5.5	4000	QFN16
TC7733FTG **	DVC	1	6	–	–	1	5.0 to 14	400/800	QFN52

** Under development

Digital Step-Down DC-DC Converter IC

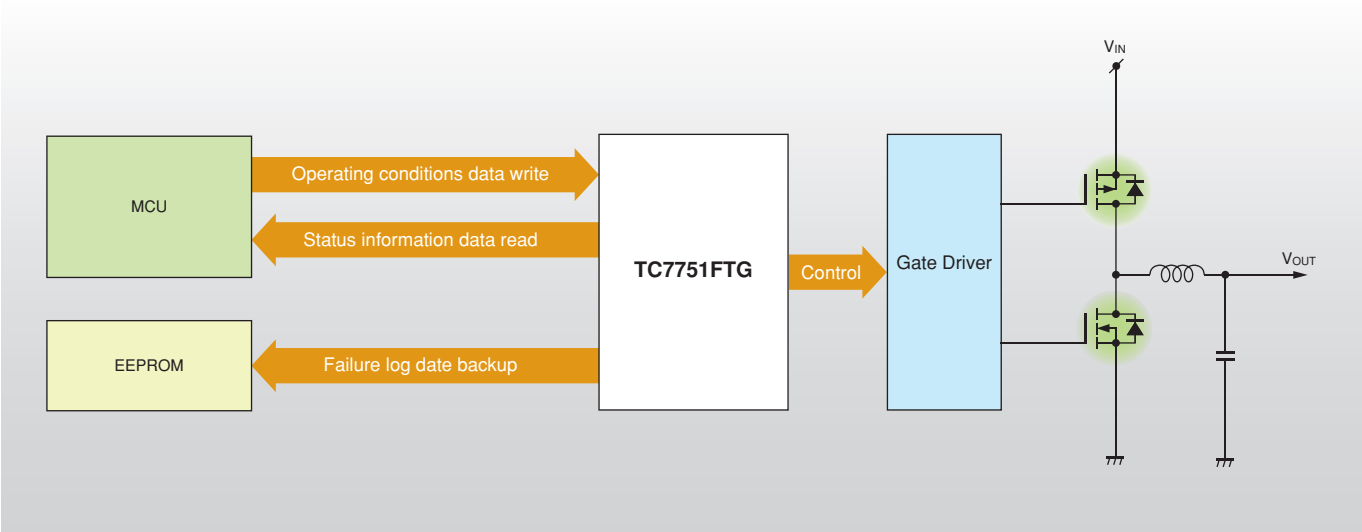
Features

Toshiba offers a buck DC-DC converter IC using digital feedback control. To reduce power consumption and board space, the TC7751FTG provides digital control in hardware that has previously been implemented as firmware running on a DSP or MCU core. The TC7751FTG has state monitoring functions for current, voltage and temperature to detect system power supply faults early. Not only does it feed back the state information to a host but also activates a protection circuit to protect itself. The communication features of the TC7751FTG can also be used to feed back the state of system power supply changes as well as to program the output voltage, monitoring thresholds, etc. Thus, the TC7751FTG allows you to address various needs for DC-DC converters.

Application Examples

- POL power supplies (servers, printers, etc.)

Application Circuit Example



Part Number	Type	Output Current (A)	Operating Input Voltage (V)	Output Voltage (V)	Switching Frequency (kHz)	Package
TC7751FTG **	Controller	35 *1	3.0 to 5.5	0.6 to 4.3	100 to 1000	QFN28

**: Under development *1: Depends on external MOSFET.

Rechargeable Lithium-Ion Battery Charger

TC7710WBG

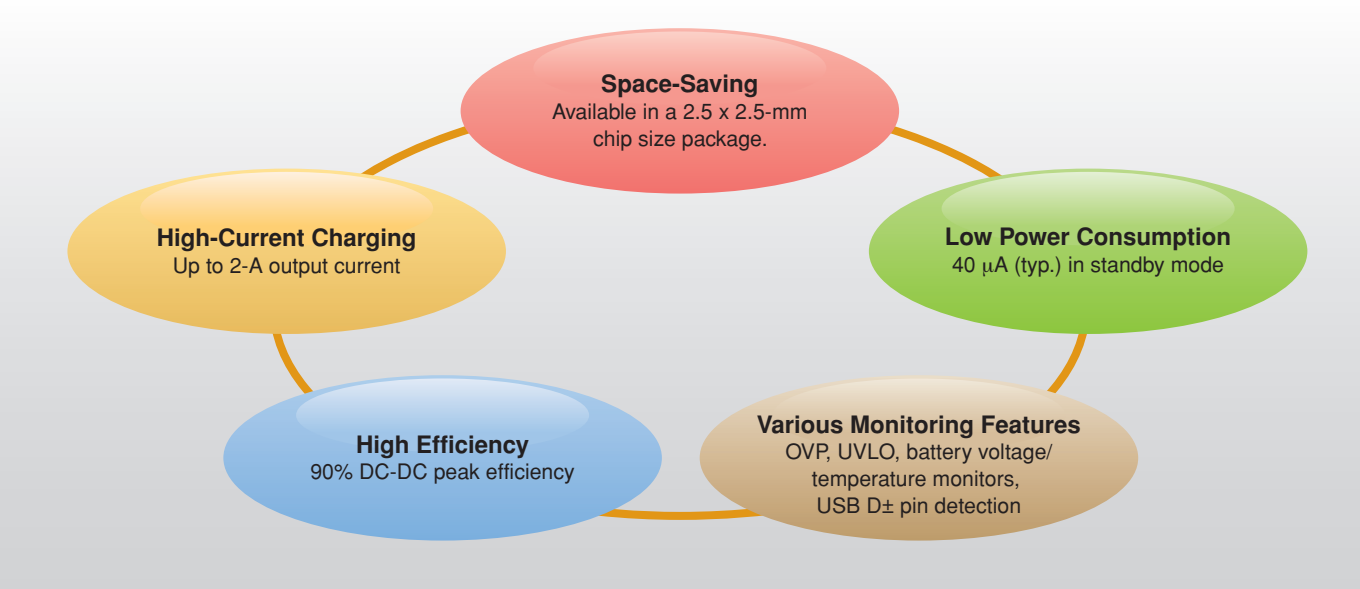
Features

Many mobile devices have an embedded high-capacity lithium-ion battery pack in order to deliver extended playtime for wide-ranging applications such as music, video and games. Manufacturers of mobile devices have been striving to keep its charge time equal to or less than the predecessor. The TC7710WBG provides the ideal solution for rechargeable lithium-ion battery chargers with a USB port. It is compliant with the Battery Charging Specification 1.2. Due to the adoption of a DC-DC converter, it offers high efficiency and a high charge current of 2 A.

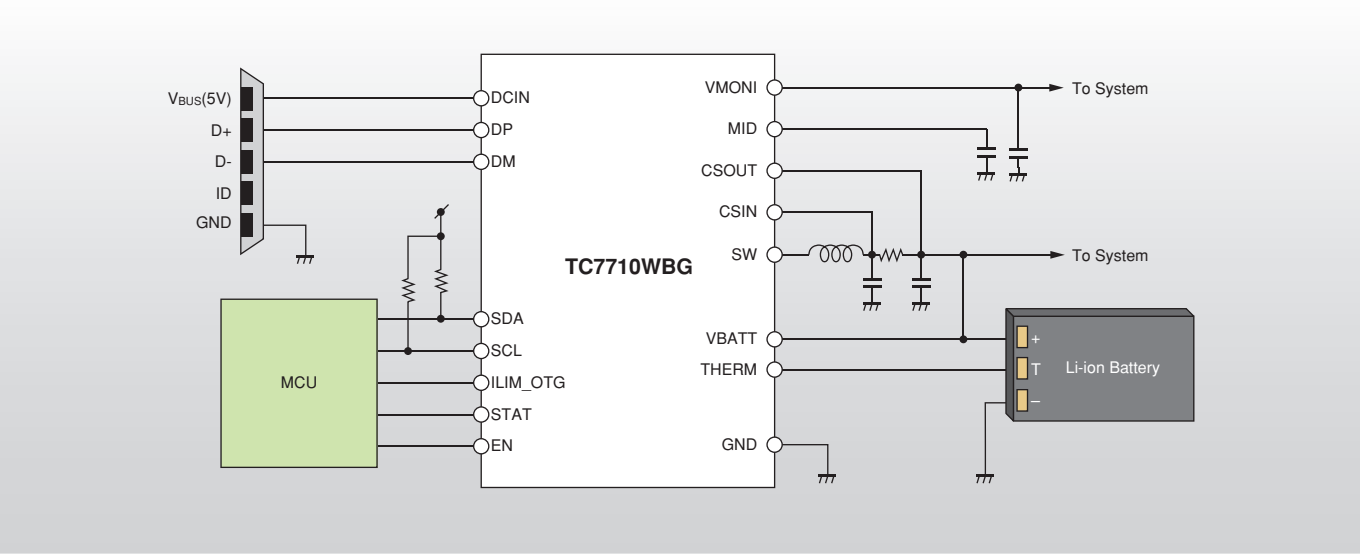
Application Examples

- Devices with a rechargeable lithium-ion battery (e.g., cell phones, digital still cameras)

Five Benefits



Application Circuit Example



Product Lineup

Part Number	Operating Input Voltage (V)	Input Current (A)	Output Voltage (V)	Output Current (A)	Switching Frequency (kHz)	Package
TC7710WBG **	4.3 to 6.5	2 (max)	3.46 to 4.72	2 (max)	3000	WCSP25

**: Under development

Product Overview:
Devices for DC-DC Converter Applications

Low-Voltage MOSFETs for DC-DC Converter Applications (V_{DSS} = 30 to 100 V)

By employing microfabrication technology and reducing the gate charge, the power MOSFET series achieves extremely high speed and low $R_{DS(ON)}$.

Features

- Low $R_{DS(ON)}$
- High-speed switching
- Total gate charge (Qg) reduction
- High avalanche capability

Product Lineup

Configuration		Absolute Maximum Ratings			Part Number	Package	$R_{DS(ON)}$(mΩ) Max.		Qg(nC) Typ.	Qsw(nC) Typ.	Series
		V_{DSS}(V)	V_{GSS}(V)	I_D(A)			V_{GS} = 10 V	V_{GS} = 4.5 V	V_{DD} = V_{DSS} x 0.8		
N-ch	Single	30	±20	9	TPCC8067-H	TSON Advance	25	33	9.5	1.9	U-MOSVII-H
				11	TPCC8066-H		15	19	15	3.2	U-MOSVII-H
				13	TPCC8068-H		11.6	16	14	3.3	U-MOSVII-H
				13	TPCC8065-H		11.4	14.5	20	4.3	U-MOSVII-H
				19	TPCC8064-H		8.2	10.6	23	5	U-MOSVII-H
				27	TPCC8062-H		5.6	7.1	34	7.4	U-MOSVII-H
				15	TPCA8068-H	SOP Advance	11.6	16	14	3.3	U-MOSVII-H
				16	TPCA8065-H		11.4	14.5	20	4.3	U-MOSVII-H
				20	TPCA8064-H		8.2	10.6	23	5	U-MOSVII-H
				22	TPCA8063-H		6.8	8.7	27	5.9	U-MOSVII-H
				28	TPCA8062-H		5.6	7.1	34	7.4	U-MOSVII-H
				32	TPCA8059-H		3.8	4.8	41	9.1	U-MOSVII-H
				38	TPCA8058-H		3	3.8	51	12	U-MOSVII-H
				42	TPCA8057-H		2.6	3.2	61	14	U-MOSVII-H
				48	TPCA8056-H		2.2	2.7	74	17	U-MOSVII-H
				56	TPCA8055-H		1.9	2.3	91	21	U-MOSVII-H
		40		20	TPCA8052-H		11.3	13.1	25	6.8	U-MOSVI-H
				32	TPCA8047-H		7.3	8.5	43	13	U-MOSVI-H
				38	TPCA8046-H		5.4	6.3	55	15	U-MOSVI-H
				46	TPCA8045-H		3.6	4.1	90	23	U-MOSVI-H
		60		(11)	TPN22006NH **	TSON Advance	(22)	–	(10)	(4.5)	U-MOSVIII-H
				(13)	TPN14006NH **		(13.9)	–	(16)	(6.9)	U-MOSVIII-H
				(27)	TPN7R506NH **		(7.5)	–	(24)	(10)	U-MOSVIII-H
				15	TPCA8053-H	SOP Advance	22.3	24	25	6.9	U-MOSVI-H
				14	TPH14006NH		14	–	16	6.3	U-MOSVIII-H
				22	TPH7R506NH		7.5	–	31	14	U-MOSVIII-H
				24	TPCA8050-H		14.2	15.3	41	10	U-MOSVI-H
				28	TPCA8049-H		10.4	11.2	55	13	U-MOSVI-H
				28	TPH5R906NH		5.9	–	38	18	U-MOSVIII-H
				32	TPH4R606NH		4.6	–	49	19	U-MOSVIII-H
				35	TPCA8048-H		6.6	7.1	90	19	U-MOSVI-H
		80		9.6	TPN30008NH **	TSON Advance	30	–	11	4.1	U-MOSVIII-H
				(18)	TPN13008NH **		(13.3)	–	(18)	(6.7)	U-MOSVIII-H
				24	TPH12008NH **	SOP Advance	12.3	–	22	8.1	U-MOSVIII-H
				28	TPCA8051-H		9.4	9.8	91	18	U-MOSVI-H
				34	TPH8R008NH **		8	–	35	13	U-MOSVIII-H
		100		9.4	TPN3300ANH **	TSON Advance	33	–	11	4.5	U-MOSVIII-H
				(17)	TPN1600ANH **		(16)	–	(19)	(7.4)	U-MOSVIII-H
				24	TPH1400ANH **	SOP Advance	13.6	–	22	9.4	U-MOSVIII-H
				32	TPH8R80ANH **		8.8	–	33	13	U-MOSVIII-H
MOSBD		30		35	TPCA8A11-H	SOP Advance	3.6	4.6	46	10	U-MOSVII-H
				40	TPCA8A10-H		3	3.8	57	12	U-MOSVII-H
				51	TPCA8A09-H		2.3	2.8	82	17	U-MOSVII-H

**: Under development(All specs are preliminary.)

Bipolar Power Transistors for self-Excited DC-DC Converter Applications

Product Lineup

Package	Part Number	Absolute Maximum Ratings				h_{FE}				V_{CE}(sat) Max		
		V_{CEX} (V)	V_{CEO} (V)	I_C (A)	P_C (W)	Min	Max	V_{CE} (V)	I_C (A)	(V)	I_C (A)	I_B (mA)
TSM	2SC6061	150	120	1	0.625 *1	120	300	2	0.1	0.14	0.3	10
PS-8	TPCP8510	150	120	1	1.1 *1	120	300	2	0.1	0.14	0.3	10
	TPCP8507	150	120	1	1.25 *1	120	300	2	0.1	0.14	0.3	10
PW-Mold	2SC6076	160	80	3	10 *2	180	450	2	0.5	0.5	1	100
PW-Mini	2SC6124	160	80	2	1 *1	100	200	2	0.5	0.5	1	100

*1: Mounted on FR4 board (Cu area: 645 mm²; glass epoxy; t = 1.6 mm) *2: Tc = 25°C

Load Switch ICs (Low On-Resistance, Low-Voltage Operation, Additional Features, Ultra-Small Package)

TCK10xG Series

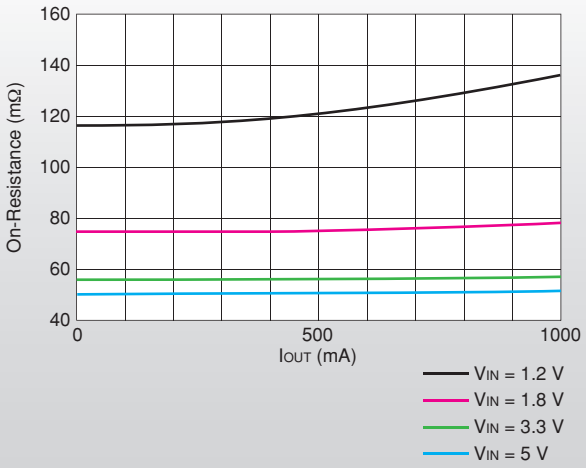
The TCK10xG Series consists of CMOS load switch ICs with low-voltage operation, low on-resistance, low current consumption and a control input pin. It features a wide operating voltage range of 1.1 to 5.5 V and low on-resistance of 55 mΩ typical (V_{IN} = 3.3 V, 500 mA). Additionally, all the load switches of the TCK10xG Series have inrush current reduction and thermal shutdown circuits. An auto discharge function and an overcurrent protection circuit are available on some load switches. Those without overcurrent protection provide an output current of 1 A, while those with overcurrent protection are offered with output currents of 0.2 A, 0.5 A and 0.8 A.

The TCK10xG Series is housed in an ultra-small WCSP6 package with a lead pitch of 0.4 mm (measuring 0.8 mm x 1.2 mm x 0.64 mm (max)), making it ideal for applications that require high-density assembly such as portable devices.

Features

- Wide operating voltage range (V_{IN} = 1.1 to 5.5 V)
- Low Ron
  R_{ON} = 50 mΩ (typ.) @ V_{IN} = 5.0 V, 500 mA
  R_{ON} = 55 mΩ (typ.) @ V_{IN} = 3.3 V, 500 mA
  R_{ON} = 75 mΩ (typ.) @ V_{IN} = 1.8 V, 500 mA
  R_{ON} = 120 mΩ (typ.) @ V_{IN} = 1.2 V, 800 mA
- Low current consumption
  I_Q = 8 μA (typ.) @ I_{OUT} = 0 mA
  (TCK101G, TCK102G)
  I_Q = 20 μA (typ.) @ I_{OUT} = 0 mA
  (TCK103G, TCK104G, TCK105G)
- Low standby current ($I_{Q(OFF)}$ = 0.1 μA (typ.)
- Inrush current reduction circuit
- Overcurrent protection circuit (except TCK101G and TCK102G)
- Thermal shutdown circuit
- Auto discharge (except TCK102G)
- Control pin connected to a pull-down resistor
- Ultra-small package
  WCSP6 (0.8 mm x 1.2 mm x 0.64 mm(max))

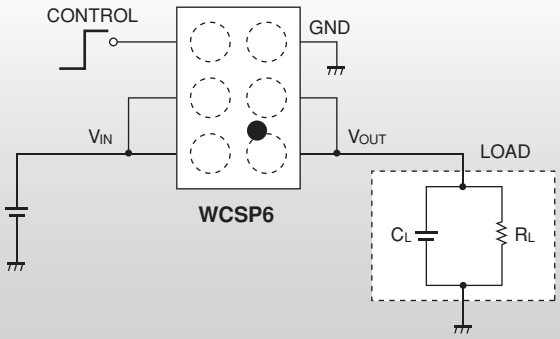
On-Resistance of the TCK101G and TCK102G (Ta= 25˚C)



Application Examples

- Cell phones
- Digital still cameras
- Small portable devices
- Portable audio players
- Tablet PCs

Application Circuit Example



CONTROL	VOUT
HIGH	ON
LOW	OFF
OPEN	OFF

Note: The products listed below are under development; their specifications are subject to change without notice.

Product Lineup

Part Number	Operating Voltage (V)	Features			
		Overcurrent Protection	Thermal Shutdown	Auto Discharge	Control Pin Connection
TCK101G**	1.1 to 5.5	–	Y	Y	Pull-down
TCK102G**		–	Y	–	Pull-down
TCK103G**		Y (Up to 200 mA)	Y	Y	Pull-down
TCK104G**		Y (Up to 500 mA)	Y	Y	Pull-down
TCK105G**		Y (Up to 800 mA)	Y	Y	Pull-down

**: Under development

CMOS LDO Regulators

TCR2EN, TCR2EE and TCR2EF Series

Toshiba offers a robust portfolio of LDO regulators ranging from general-purpose products to high-end products ideal for applications requiring high accuracy and high stability that are particularly needed for analog circuitry.

The TCR2EN, TCR2EE and TCR2EF Series are fabricated with a newly developed CMOS process to deliver a significant improvement in performance/size trade-offs. While physically small, these single-output LDO regulators offer a small voltage dropout, an output current (I_{OUT}) of 200 mA and a control pin. Additionally, the TCR2EN, TCR2EE and TCR2EF Series provide a low output noise, fast load transient response, automatic output discharge, thermal shutdown, etc. and can be used for a broad range of applications. Wide packaging options include an ultra-small SDFN4 (measuring 0.8 mm x 0.8 mm x 0.38 mm), a general-purpose ESV also known as SOT-553 (measuring 1.6 x 1.6 x 0.55 mm), SMV also known as SOT25 (measuring 2.9 x 2.8 x 1.1 mm), etc.

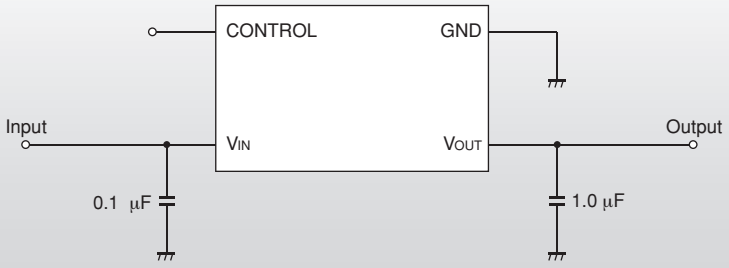
Features

- Low dropout voltage
  V_{IN}-V_{OUT} = 160 mV (typ.) @ 2.5-V output, I_{OUT} = 150 mA
  V_{IN}-V_{OUT} = 210 mV (typ.) @ 1.8-V output, I_{OUT} = 150 mA
  V_{IN}-V_{OUT} = 490 mV (typ.) @ 1.0-V output, I_{OUT} = 150 mA
- Low output noise voltage: V_{NO} = 35 μVrms (typ.)
  @ 2.5-V output, I_{OUT} = 10 mA, 10 Hz < f < 100 kHz
- Load transient response: ΔV_{OUT} = ±55 mV (typ.)
  @ I_{OUT} = 1 ↔ 150 mA, C_{OUT} =1.0 uF
- Low bias current: I_B = 35 μA (typ.) @ I_{OUT} = 0 mA
- High ripple rejection ratio: (R.R = 73 dB (typ.)
  @ 2.5-V output, I_{OUT} = 10 mA, f =1 kHz
- Available with output voltage from 1.0 V to 3.6 V (fixed output voltage)
- High output voltage accuracy: ±1.0% (V_{OUT} ≥1.8 V)
- Automatic output discharge; control pin connected to a pull-down resistor
- Allows use of ceramic capacitors on the input and output lines (C_{IN} = 0.1uF, C_{OUT} =1.0 uF)

Application Examples

- Cell phones
- Digital still cameras (DSCs)
- Small portable devices
- Televisions
- PCs
- DVD and Blu-ray recorders
- Portable audio players

Application Circuit Example



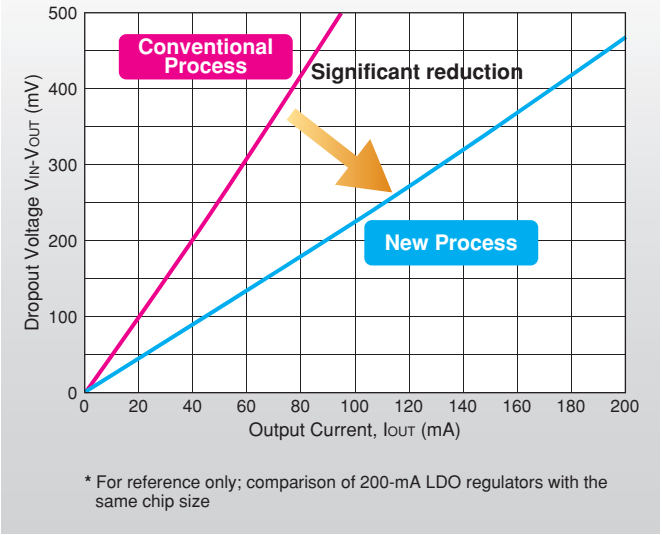
CONTROL	VOUT
HIGH	ON
LOW	OFF
OPEN	OFF

For stable operation, capacitors should be connected to the input and output lines. (Ceramic capacitors can be used.)

● Typical Performance (TCR2EN Series)

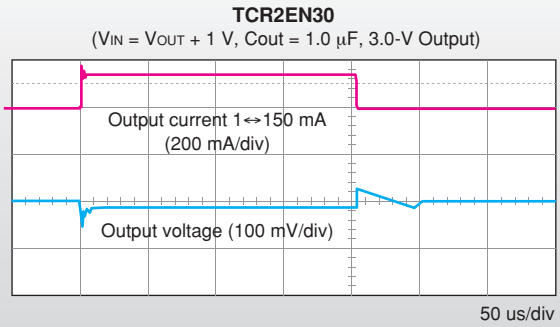
The TCR2EN Series features a low dropout voltage of 160 mV (at 2.5-V output and I_{OUT} = 150 mA). Additionally, it offers a low output noise voltage of 35 μVrms (at 2.5-V output) and a fast load transient response of ΔV_{OUT} = ±55 mV (I_{OUT} = 1mA ↔150 mA, C_{OUT} =1.0 μF).

Comparison of Voltage Dropout Performance Between 1.2-V LDO Regulators



* For reference only; comparison of 200-mA LDO regulators with the same chip size

Load Transient Response Performance



● Product Lineup

Series	Output Current	Output Voltage	Overcurrent Protection	Automatic Output Discharge (Pulled-Down Control Pin)	Package
TCR2ENxx *	200	1.0 to 3.6	○	○	SDFN4
TCR2EExx **	200	1.0 to 3.6 *1	○	○	ESV(SOT-553)
TCR2EFxx **	200	1.0 to 3.6 *1	○	○	SMV(SOT25)

*1: If you have any requests for output voltage, etc., feel free to contact your local Toshiba sales representative.

:** New products *:** Under development

OVERSEAS SUBSIDIARIES AND AFFILIATES

(As of October 1, 2012)

Toshiba America Electronic Components, Inc.
- Irvine, Headquarters
  Tel: (949)623-2900 Fax: (949)474-1330
- Buffalo Grove (Chicago)
  Tel: (847)484-2400 Fax: (847)541-7287
- Duluth/Atlanta
  Tel: (770)931-3363 Fax: (770)931-7602
- El Paso
  Tel: (915)771-8156
- Marlborough
  Tel: (508)481-0034 Fax: (508)481-8828
- Parsippany
  Tel: (973)541-4715 Fax: (973)541-4716
- San Jose
  Tel: (408)526-2400 Fax: (408)526-2410
- Wixom (Detroit)
  Tel: (248)347-2607 Fax: (248)347-2602

Toshiba Electronics do Brasil Ltda.
Tel: (011)2936-6681 Fax: (011)2936-6675

Toshiba India Private Ltd.
- New Deli Office
  Tel: (0124)499-6600 Fax: (0124)499-6611
- Bangalore Office
  Tel: (080)251-90800 Fax: (080)490-91945

Toshiba Electronics Europe GmbH
- Düsseldorf Head Office
  Tel: (0211)5296-0 Fax: (0211)5296-400
- France Branch
  Tel: (1)47282181
- Italy Branch
  Tel: (039)68701 Fax: (039)6870205
- Munich Office
  Tel: (089)20302030 Fax: (089)203020310
- Spain Branch
  Tel: (91)660-6798 Fax: (91)660-6799
- Sweden Branch
  Tel: (08)704-0900 Fax: (08)80-8459
- U.K. Branch
  Tel: (0870)060-2370 Fax: (01252)53-0250

Toshiba Vietnam Consumer Products Co.,Ltd.
Tel: (043)776-5950 Fax: (043)776-5956

Toshiba Electronics Asia (Singapore) Pte. Ltd.
Tel: (6278)5252 Fax: (6271)5155

Toshiba Electronics Service (Thailand) Co., Ltd.
Tel: (02)501-1634 Fax: (02)501-1638

Toshiba Electronics Trading (Malaysia)Sdn. Bhd.
- Kuala Lumpur Head Office
  Tel: (03)5631-6311 Fax: (03)5631-6307
- Penang Office
  Tel: (04)226-8523 Fax: (04)226-8515

Toshiba Electronics (Shanghai) Co., Ltd.
- Shanghai Head Office
  Tel: (021)6139-3888 Fax: (021)6190-8288
- Beijing Branch
  Tel: (010)6590-8796 Fax: (010)6590-8791
- Chengdu Branch
  Tel: (028)8675-1773 Fax: (028)8675-1065
- Hangzhou Office
  Tel: (0571)8717-5004 Fax: (0571)8717-5013
- Nanjing Office
  Tel: (025)8689-0070 Fax: (025)8689-0125
- Qingdao Branch
  Tel: (532)8579-3328 Fax: (532)8579-3329
- Shenzhen Branch
  Tel: (0755)2399-6897 Fax: (0755)2399-5573
- Dalian Branch
  Tel: (0411)8368-6882 Fax: (0411)8369-0822

Toshiba Electronics Asia, Ltd.
Tel: 2375-6111 Fax: 2375-0969

Tsurong Xiamen Xiangyu Trading Co., Ltd.
Tel: (0592)226-1398 Fax: (0592)226-1399

Toshiba Electronics Korea Corporation
Tel: (02)3484-4334 Fax: (02)3484-4302

Toshiba Electronics Taiwan Corporation
Tel: (02)2508-9988 Fax: (02)2508-9999

Previous edition: SCE0024F

TOSHIBA

TOSHIBA CORPORATION
Semiconductor & Storage Products Company

Website: http://www.semicon.toshiba.co.jp/eng

2012-12
SCE0024G

Semiconductors for Power Supplies