



3Q 2002

Low-Power DC/DC Converters

Buck/Boost Charge Pumps

2 90% efficient, 30-mA buck/boost charge pump 25-mA charge pump

Boost Charge Pumps

- **3** 100-mA dual-cell charge pump Single-cell charge pump
- **4** Single-cell charge pump with 2-µA snooze mode

Inverter Charge Pumps

4 98% efficient inverting charge pump

Buck Charge Pumps

5 250-mA buck charge pump

Boost Converters

- **5** 95% efficient boost converter
- 6 Boost converter for LCD and white LED

88% efficient boost converter

7 Single- and dual-cell, 92% efficient boost converter Dual-output boost converter

Buck Converters

8 97% efficient synchronous buck converter 600-mA synchronous buck converter

Resources

- 9 Charge pump/Inductive DC/DC converter family trees
- 10 Low-power DC/DC converter selection guides

Order your free copy of the UPDATED **'Power Management Selection Guide**



(see reply card for details)

Page 8 TPS6220x, 97% efficient step-down converter in SOT-23







SOT-23 package

Page 7

output DC/DC

converter with

integrated LDO

offers complete

power supply

solution in

one device





QFN/MLP-24 package

Buck/Boost Charge Pumps

90% efficient, 30-mA buck/boost charge pump in SOT-23

REG710 & REG711



Get samples, datasheets, EVMs and app reports at: www.ti.com/sc/device/reg710 www.ti.com/sc/device/reg711

- Automatic voltage step-up/step-down regulation
- Wide input voltage range: 1.8 V to 5.5 V
- Maximum efficiency: 90%
- Typical shutdown current: 0.01 µA
- Thermal protection and current limit
- 6-pin SOT-23 package (REG710)
- 8-pin MSOP package (REG711)
- Suggested resale price starts at \$0.90 each (quantities of 1,000)

Available Device Options

Device	Output current (mA)	Output voltage (V)
REG710	30	2.5, 2.7, 3.0, 3.3, 5.0
REG711	50	2.5, 2.7, 3.0, 3.3, 5.0

Application with LED Circuit



Typical applications:

- Smart card readers
- SIM card supplies
- PCMCIA cards
- Cellular phones
- Notebook, palm-top computers and modems
- White LED driver and LCD displays
- Battery backup supplies

25-mA charge pump ideally suited for VCO and PLL applications

TPS6024x



www.ti.com/sc/device/tps60240

- Automatic voltage step-up/step-down regulation
- Wide-input voltage range: 1.8 V to 5.5 V
- Zero-ripple output: $170-\mu V_{rms}$
- Maximum efficiency: 90%
- Typical shutdown current: 0.1 µA
- Thermal protection and current limit
- 8-pin MSOP package
- Suggested resale price starts at \$1.57 each (quantities of 1,000)

Available Device Options

Device	Output current	Output voltage
	(mA)	(V)
TPS60240	25	3.3
TPS60241	25	5.0
TPS60242	25	2.7
TPS60243	25	3.0

Application with VCO Circuit



- VCO and PLL power for PDA phone, cellular phones and PCMCIA modems
- Smart card readers
- Digital cameras
- MP3 players
- SIM modules and memory backup
- Handheld meters

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100-mA charge pump with 2-µA quiescent current

TPS6020x/TPS6021x

Get samples, datasheets, EVMs and app reports at: www.ti.com/sc/device/tps60200 www.ti.com/sc/device/tps60210

- Input voltage: 1.8 V to 3.6 V
- Low noise: 5 mV_{rms}
- Maximum efficiency: 90%
- 2-µA quiescent current in snooze mode (TPS6021x)
- Typical shutdown current: 0.05 µA
- Shutdown, low battery or Power Good feature
- Package: 10-pin MSOP
- Suggested resale price starts at \$1.29 each (quantities of 1,000)

Available Device Options

Device	Output	Output	Quiescent
	current	voltage	current
	(mA)	(V)	(μA)
TPS60200/1	100	3.3	40
TPS60202/3	50	3.3	40
TPS60204/5	100	3.3	35
TPS60210/1	100	3.3	2
TPS60212/3	50	3.3	2

Application with Low-Battery Warning and Snooze Mode Pin



Typical applications:

- \bullet Two battery cells to 3.3-V conversion
- MP3 portable audio players
- Battery-powered microprocessor systems
- Backup-battery boost converters
- PDAs, organizers, cordless phones
- Handheld instrumentation

Single-cell to 3.0-V/3.3-V, dual-output charge pump

TPS6030x



www.ti.com/sc/device/tps60300

- Input voltage: 0.9 V to 1.8 V
- Maximum efficiency: 90%
- Quiescent current: 35 µA
- Typical shutdown current: $0.05 \ \mu A$
- Power Good feature
- Package: 10-pin MSOP
- Suggested resale price starts at \$1.26 each (quantities of 1,000)

Available Device Options

Device	Output	Output
	current	voltage
	(mA)	(V)
TPS60300/2	40	3.3
TPS60301/3	40	3.0

Efficiency Over Alkaline Battery Operating Time



- Smart card readers
- SIM card supplies
- Healthcare products (e.g., toothbrush)
- Metering applications using MSP430 microcontroller
- Notebook, palm-top computers and modems
- Battery backup supplies

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Boost Charge Pumps

Single-cell to 3.0-V/3.3-V, dual charge pump with 2-µA snooze mode

TPS6031x

Get samples, datasheets, EVMs and app reports at: www.ti.com/sc/device/tps60310

- Input voltage: 0.9 V to 1.8 V
- Maximum efficiency: 90%
- 2-µA quiescent current in snooze mode
- Typical shutdown current: 0.01 μA
- Power Good feature
- Package: 10-pin MSOP
- Suggested resale price starts at \$1.42 each (quantities of 1,000)

Available Device Options

Device	Output	Output	Quiescent
	current	voltage	current
	(mA)	(V)	(μA)
TPS60310/2	40	3.3	2
TPS60311/3	40	3.0	2

Application with MSP430 Microcontroller



Typical applications:

- Smart card readers
- SIM card supplies
- Healthcare products (e.g., toothbrush)
- Metering applications using TI's MSP430 ultra-low-power microcontroller
- Notebook, palm-top computers and modems
- Battery backup supplies

Inverter Charge Pumps

98% efficient, inverting charge pump in SOT-23

TPS6040x



Get samples, datasheets, EVMs and app reports at: www.ti.com/sc/device/tps60400

- Input voltage: 1.6 V to 5.5 V
- Pin-compatible parts
- Output voltage: - V_{IN}
- Output current: 60 mA
- Maximum efficiency: 98%
- PowerSave mode
- Package: 5-pin SOT-23
- Pin-compatible to MAX828, SP6828, LM828, ICL828, TC828, ADM8828
- Suggested resale price starts at \$0.46 each (quantities of 1,000)

Available Device Options

Device	Switching	Quiescent
	frequency	current
	(kHz)	(µA)
TPS60400	50 - 250	125
TPS60401	20	65
TPS60402	50	120
TPS60403	250	425

Typical Application



- LCD bias
- GaAs bias for RF power amplifiers
- Sensor supply in portable instruments
- Bipolar amplifier supply
- Medical instruments
- Battery-operated equipment

SINE ON LOW-POWER DC/DC CONVERTERS 5

Buck Charge Pumps

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250-mA, buck charge pump in MSOP-8

TPS6050x

30, 2002



Get samples, datasheets, EVMs and app reports at: www.ti.com/sc/device/tps60500

- Input voltage: 1.8 V to 6.5 V
- Maximum efficiency: 90%
- Quiescent current: 40 µA
- Over-current and over-temperature protected
- Output-voltage supervisor included
- Package: 10-pin MSOP
- Suggested resale price starts at \$1.35 each (quantities of 1,000)

Available Device Options

Device	Output current	Output voltage
	(mA)	(V)
TPS60500	250	0.8 - 3.3
TPS60501	250	3.3
TPS60502	250	1.8
TPS60503	250	1.5

TPS60502 Powered by One Li-Ion Cell



Typical applications:

- PDAs
- DSP core supply
- Cellular phones
- Portable instruments
- Internet audio players
- PC peripherals
- USB-powered applications

Boost Converters

95% efficient, 1-A boost converter with low battery indicator

TPS6103x



Get samples, datasheets, EVMs and app reports at: www.ti.com/sc/device/tps61030 * Available 40 '02

- Input voltage: 1.8 V to 7.0 V
- Maximum efficiency: 95%
- Quiescent current: 50 µA
- Output current: 1 A
- Typical shutdown current: 5 µA
- Package: 16-pin TSSOP PowerPAD[™]
- Suggested resale price starts at \$2.25 each (quantities of 1,000)

Available Device Options

Application Example

Device	Switch current	Output voltage
	(mA)	(V)
TPS61030	5000	1.8 - 5.5
TPS61031	5000	3.3
TPS61032	5000	5.0



- Battery-powered end equipments
- Portable communication devices
- PDAs, notebooks
- GPS systems
- Keyless entry systems
- Personal medical systems

Boost Converters

Boost converter for LCD bias and white LED backlight supply in SOT-23

TPS6104x

NEW



Get samples, datasheets, EVMs and app reports at: www.ti.com/sc/device/tps6104

- Input voltage: 1.8 V to 6.0 V
- Maximum efficiency: 85%
- Quiescent current: 28 µA
- Output current: 100 mA (TPS61040) 45 mA (TPS61041)
- Typical shutdown current: 1 µA
- Maximum switching frequency: 1 MHz
- Package: 5-pin SOT-23
- Suggested resale price \$0.95 each (quantities of 1,000)

Available Device Options

Device	Switch current limit	Output voltage
	(mA)	(V)
TPS61040	400	3.3 - 28.0
TPS61041	250	3.3 - 28.0

Application Example



Typical applications:

- LCD bias supply
- White LED backlight supply
- Digital still camera
- PDAs, organizers, handhelds
- Cellular phones
- Standard 3.3/5.0 V to 12-V conversion
- Dual cell to 5-V conversion

88% efficient, 250-mA boost converter

TPS6100x

M P V

Get samples, datasheets, EVMs and app reports at: www.ti.com/sc/device/tps61000

- Guaranteed start-up into full load with supply voltage as low as 0.9 V over full temperature
- Guaranteed output current of 100 mA at 3.3-V Vout and 0.8-V VIN $\,$
- High-power conversion efficiency (> 88%)
- PowerSave mode for improved efficiency at low output currents
- Device quiescent current < $50 \ \mu A$
- Low-battery comparator
- Low-electromagnetic interference converter (integrated anti-ringing switch across inductor)
- Package: 10-pin MSOP
- Suggested resale price starts at \$1.35 each (quantities of 1,000)

Available Device Options

Device	Input	Output
	voltage	voltage
	(V)	(V)
TPS61000	0.8 - 3.3	1.5 - 3.3
TPS61001	0.8 - 1.5	1.5
TPS61002	0.8 - 1.8	1.8
TPS61003	0.8 - 2.5	2.5
TPS61004	0.8 - 2.8	2.8
TPS61005	0.8 - 3.0	3.0
TPS61006	0.8 - 3.3	3.3
TPS61007	0.8 - 3.3	0.8 - 3.3

Application Circuit for Fixed Output Voltage Option



- MP3 players
- Wireless headsets and handsets
- Pagers
- Remote controls
- Healthcare products (e.g., portable diagnostic equipment)

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Boost Converters

Single- and dual-cell, 92% efficient, synchronous boost converter in chipscale package

TPS6101x

Get samples, datasheets, EVMs and app reports at: www.ti.com/sc/device/tps61010

- Input voltage: 0.8 V to 3.3 V
- Maximum efficiency: 92%
- Output current: 200 mA
- Quiescent current: 50 µA
- Typical shutdown current: 1 µA
- Integrated low battery comparator
- Integrated anti-ringing switch across inductor
- Auto-discharge during shutdown
- Package: 10-pin MSOP, 12-ball chip-scale package (4Q '02)
- Suggested resale price starts at \$1.59 each (quantities of 1,000)

Available Device Options

Device	Input	Output
	voltage	voltage
	(V)	(V)
TPS61010	0.8 - 3.3	1.5 - 3.3
TPS61011	0.8 - 1.5	1.5
TPS61012	0.8 - 1.8	1.8
TPS61013	0.8 - 2.5	2.5
TPS61014	0.8 - 2.8	2.8
TPS61015	0.8 - 3.0	3.0
TPS61016	0.8 - 3.3	3.3

Typical Application



Typical applications:

- Internet audio players
- Pagers
- Portable medical diagnostic equipment
- Remote controls
- Wireless headsets
- PDAs
- Digital still cameras

Dual-output, 200-mA synchronous boost converter with integrated LDO

TPS6110x



Get samples, datasheets, EVMs and app reports at: www.ti.com/sc/device/tps61100

- Boost input voltage: 0.8 V to 3.6 V ideal for 1- and 2- cell Alkaline batteries
- LDO input voltage 1.5 V to 7 V
- Maximum efficiency: 95%
- Output current: 200 mA from 0.8-V supply
- Quiescent current: 65 µA
- Typical shutdown current: 0.6 µA
- Low EMI, thermal protection and Power Good
- Battery supervision
- Package: 20-pin TSSOP, 4 x 4 mm² MLP/QFN-24
- Suggested resale price starts at \$1.75 each (quantities of 1,000)

Available Device Options

Device	V _{OUT} DC/DC	V _{OUT} LDO
	(V)	(V)
TPS61100	1.5 - 5.5	0.9 - 3.6
TPS61103	3.3	0.9 - 3.6
TPS61106	3.3	1.5

Application Example



- TMS320C5000[™] DSP platform
- MP3 players, digital still cameras
- PDAs, notebooks
- Other battery-powered end equipments

Buck Converters

NEW

97% efficient, ultra-low-power, 300-mA synchronous buck converter in SOT-23

TPS6220x



Get samples, datasheets, EVMs and app reports at: www.ti.com/sc/device/tps62200

- Input voltage: 2.5 V to 6.0 V
- Maximum efficiency: 97%
- Quiescent current: 15 µA
- Typical shutdown current: 0.1 μA
- Package: 5-pin SOT-23
- Suggested resale price starts at \$1.50 each (quantities of 1,000)

Available Device Options

Device	Output current	Output voltage
	(mA)	(V)
TPS62200	300	0.7 - 6.0
TPS62201	300	1.5
TPS62202	300	1.8
TPS62203	300	3.3
TPS62204	300	1.6
TPS62205	300	2.5

Application with Only Three External Components



Typical applications:

- Low-power CPUs and DSPs
- Cellular phones
- Organizers, PDAs and handheld PCs
- MP3 portable audio players
- Digital cameras
- USB-based DSL modems

600-mA, 95% efficient synchronous buck converter in chip-scale package

TPS6200x



www.ti.com/sc/device/tps62000

- Input voltage: 2.0 V to 5.5 V
- Maximum efficiency: 95%
- Quiescent current: 50 µA
- Output current: 600 mA
- Typical shutdown current: 0.1 µA
- Package: 10-pin MSOP, chip-scale package (4Q '02)
- Suggested resale price starts at \$1.69 each (quantities of 1,000)

Available Device Options

Device	Output current	Output voltage
	(mA)	(V)
TPS62000	600	0.8 - 5.5
TPS62001	600	0.9
TPS62002	600	1.0
TPS62003	600	1.2
TPS62004	600	1.5
TPS62005	600	1.8
TPS62006	600	2.5
TPS62007	600	3.3
TPS62008	600	1.9

Efficiency Over Load Current



- Low-power CPUs and DSPs
- Cellular phones
- Organizers, PDAs and handheld PCs
- \bullet MP3 portable audio players
- Digital cameras
- USB-based DSL modems

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Charge Pumps Family of Products

Inductive DC/DC Converters Family of Products



Selection Guides

	Charge P	Pumps																	
	Device	V _{CC}	V _{OUT} (V)	Output Current (mA)	Switching Frequency (kHz)	Quiescent Current (µA)	Shutdown Current (µA)	Efficiency (%)	Shutdown	Low Battery	Power Good	Current Limit	Thermal Limit	S0T-23	Packag SOIC	jes/Pins MSOP	TSSOP	EVM	Price ¹
	Buck/Boost	_															_		
	REG710	1.8 to 5.5	2.5 to 5.0	30	1000	65	0.01	90	 ✓ 			 V 	V	6				V	0.90
NEW	REG711	1.8 to 5.5	2.5 to 5.0	50	1000	60	0.01	90	V			V	V			8			1.27
NEW	TPS60240/1/2/3	1.8 to 5.5	2.7/3.0/3.3/5.0	25	160	250	0.1	90				V	 V 			8		~	1.57
<u> </u>	Buck																		
NEW	TPS60500/1/2/3	1.8 to 6.5	0.9 to 3.3	250	1200	40	0.05	90	 ✓ 		V	V	V			10		V	1.35
	Boost																		
	TPS60100	1.8 to 3.6	3.3	200	300	50	0.05	90	 ✓ 			V					20	V	1.82
	TPS60101	1.8 to 3.6	3.3	100	300	50	0.05	90	 ✓ 			V					20		1.51
	TPS60110	2.7 to 5.4	5.0	300	300	60	0.05	90	V			V					20	V	1.82
	TPS60111	2.7 to 5.4	5.0	150	300	60	0.05	90	V			V					20		1.51
	TPS60120/1	1.8 to 3.6	3.3	200	450	55	0.05	90	 ✓ 	 V 	V	V					20	~	1.82
	TPS60122/3	1.8 to 3.6	3.3	100	450	55	0.05	90	V	V	V	V					20		1.51
	TPS60124/5	1.8 to 3.6	3.0	200	450	55	0.05	90	 ✓ 	 V 	V	V					20		1.82
	TPS60130/1	2.7 to 5.4	5.0	300	450	60	0.05	90	 ✓ 	 V 	V						20	V	1.82
	TPS60132/3	2.7 to 5.4	5.0	150	450	60	0.05	90	v .	×	~						20		1.51
	TPS60140/1	1.8 to 3.6	5.0	100	450	65	0.05	85	 ✓ 	 V 	V	 ✓ 					20	V	1.51
	TPS60200/1	1.8 to 3.6	3.3	100	400	35	0.05	90	 ✓ 	v -	V					10		×	1.30
	TPS60202/3	1.8 to 3.6	3.3	50	400	35	0.05	90	 ✓ 	 ✓ 	 ✓ 					10			1.30
	TPS60204/5	1.8 to 3.6	3.3	100	400	35	0.05	90	 ✓ 	v -	V					10			1.30
	TPS60210/1	1.8 to 3.6	3.3	100	400	2	0.05	90	 ✓ 	 ✓ 	 ✓ 					10		×	1.67
	TPS60212/3	1.8 to 3.6	3.3	50	400	2	0.05	90	 ✓ 	v -	V					10			1.38
NEW	TPS60300/2/1/3	0.9 to 1.8	3.3/3.0	40	900	35	0.05	90			 ✓ 					10		×	1.26
NEW	TPS60310/2/1/3	0.9 to 1.8	3.3/3.0	40	900	2	0.01	90			~					10			1.42
<u> </u>	Inverters																		
NEW	TPS60400	1.6 to 5.5	-1.6 to -5.5	60	300	125	_	95						5				~	0.46
NEW	TPS60401	1.6 to 5.5	-1.6 to -5.5	60	28	65	_	98						5					0.46
NEW	TPS60402	1.6 to 5.5	-1.6 to -5.5	60	70	120	_	98						5					0.46
NEW	TPS60403	1.6 to 5.5	-1.6 to -5.5	60	300	425	_	98						5					0.46
	LT1054	3.5 to 15.0	-5	100	25	2500	100	—	 ✓ 						16				2.10

¹Suggested resale price in U.S. dollars in quantities of 1,000.

Inductive DC/DC Converters

	maaoan																				
		Vcc	νουτ	Output Current	Switching Frequency	Quiescent Current	Shutdown Current	Efficiencv		down	Low	Power	Current	Thermal		P	ackages/F	Pins			
	Device	(V)	(V)	(mA)	(kHz)	(μA)	(µA)	(%)	LDO	Shut	Battery	Good	Limit	Limit	SOT-23	SOIC	MSOP	TSSOP	MLP/QFN	EVM	Price ¹
	Buck/Boost																				
NEW	TPS61130	1.8 to 5.5	2.5 to 5.5	300	600	40	0.3	90	1	V	V	v .	V	V				16	16	~	1.95
NEW	TPS61131	1.8 to 5.5	3.3	300	600	40	0.3	90	V	V	V	 V 	V	V				16	16	V	1.95
NEW	TPS61132	1.8 to 5.5	3.3	300	600	40	0.3	90	1	V	V	 ✓ 	V	V				16	16	~	1.95
_	UCC39421	1.8 to 8.0	2.5 to 8.0	FET	_	100	1	_		V		 ✓ 	V					16		V	2.29
	UCC39422	1.8 to 8.0	2.5 to 8.0	FET	—	100	1	—		V	V		V					20			2.39
	TL497A	4.5 to 12.0	1.2 to 30.0	500	—	11000	6000	85		V						14		14			1.33
	Buck																				
	TPS6200x	0.8 to 5.5	0.8 to 5.0	600	1000	50	1	95		V	V	V	V	V			10			V	1.69
	TPS6210x	2.5 to 9.0	0.8 to 8.0	500	300 to 2000	164	1	92		V			V	V		8				~	2.01
NEW	TPS6220x	2.5 to 6.0	0.7 to 6.0	300	1000	15	1	95		V			V	V	5					~	1.49
-	Boost																				
	TPS6100x	0.8 to 3.3	1.5 to 3.3	250	840	50	0.1	85		V	V		V				10			~	1.35
	TPS61010	0.8 to 3.3	1.5 to 3.3	200	840	50	0.1	92		V	V		V				10			~	1.59
	TPS61011	0.8 to 1.5	1.5	200	840	50	0.1	92		V	V		V				10				1.59
	TPS61012	0.8 to 1.8	1.8	200	840	50	0.1	92		V	V		V				10				1.59
	TPS61013	0.8 to 2.5	2.5	200	840	50	0.1	92		V	V		V				10			~	1.59
	TPS61014	0.8 to 2.8	2.8	200	840	50	0.1	92		V	V		V				10				1.59
	TPS61015	0.8 to 3.0	3.0	200	840	50	0.1	92		V	V		V				10			~	1.59
	TPS61016	0.8 to 3.3	3.3	200	840	50	0.1	92		V	V		V				10			V	1.59
REVIEW	TPS6103x	1.8 to 7.0	1.8 to 7.0	1000	720	25	5	97		V	V		V	V				16		~	2.25
NEW	TPS61040	1.8 to 6.0	Up to 28.0	100	1000	25	1	85		V			V		5					~	1.05
NEW	TPS61041	1.8 to 6.0	Up to 28.0	45	1000	25	1	85		V			V		5						0.95
NEW	TPS61100	0.8 to 3.6	1.5 to 5.5	200	8	65	0.5	95	v	V	V	 ✓ 	V	V				20	24	V	1.75
NEW	TPS61103	0.8 to 3.6	3.3	200	8	65	0.5	95	v	V	V	 ✓ 	V	V				20	24	~	1.75
NEW	TPS61106	0.8 to 3.6	3.3	200	8	65	0.5	95	v	V	V	 ✓ 	V	V				20	24	V	1.75
NEW	TPS61120	1.8 to 5.5	2.5 to 5.5	500	600	40	0.3	95	1	V	V	× .	V	V				16	16	~	1.85
NEW	TPS61121	1.8 to 5.5	3.3	500	600	40	0.3	95	v	V	V	 ✓ 	V	V				16	16	v .	1.85
NEW	TPS61122	1.8 to 5.5	3.6	500	600	40	0.3	95	1	V	V	 ✓ 	V	V				16	16	v .	1.85
_	UCC39411/2/3	1.0 to 3.2	2.0 to 5.0	60	500	20	5	85		V			V			8				v .	1.29
	TPS6734	2.7 to 12.0	12	225	170	1200	3	85		V				V		8				v .	1.25
	TL499A	1.1 to 10.0	2.9 to 30.0	100	-	-	15	—													0.56
	Inverters																				
	TPS6735	4.0 to 6.2	-5	200	160	1900	1	78		V						8				V	1.25
	TPS6755	2.7 to 9.0	-1.25 to -9.3	200	160	1900	1	78		V				V		8					1.25

¹Suggested resale price in U.S. dollars in quantities of 1,000.

SINE ON LOW-POWER DC/DC CONVERTERS 11



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