

# NON-ISOLATED DC/DC CONVERTERS

4.75 – 15V Input / 3.3V Output / 16A



BP02S7DC-16D330

## S7DC-16D330 Module

- Nonisolated
- Industry standard pinout
- Fixed frequency
- High efficiency means less power dissipation
- High power density
- Optimized for cost
- Remote on/off
- Programmable undervoltage lockout (UVLO)
- Over current and short circuit protection
- Two phase operation
- Non-latching over temperature shutdown protection



### Description

The Bel S7DC-16D330 module is one in a series of non-isolated, DC/DC power converters that operate from a wide input range of 3V minimum to 15V maximum. This converter is available with 3.3V output. It uses a low profile, surface mount DIP package for ease of layout and space savings. 16A maximum output is also provided. Standard features include remote on/off, over current and short circuit protection, programmable UVLO and output voltage adjust. Optional features include two-wire remote sense or single-ended remote sense with a good power signal. This module also makes use of adaptive positioning to improve transient response performance. It may be used almost anywhere low voltage silicon is employed and a 4.75 to 15V source is available. Typical applications include file servers, routers, line cards and other computing and communications equipment.

### Applications

- Telecommunications
- Networking
- Computers and peripherals

### Options

- Double-ended remote sense
- Power good signal and single-ended sense

### Part Number Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Part Number	Part Number Power Good Signal & Remote Sense	Part Number Double-ended Remote Sense
3.3V	4.75 - 15V	16A	53W	91%	S7DC-16D330	S7DC-16D33S	S7DC-16D33D

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### Absolute Maximum Ratings

Parameter	Symbol	Min	Typical	Max	Unit
Continuous Input Voltage	Vin	-0.3		15	V
Output Enable Terminal Voltage <sup>1</sup>	Vouten	-0.3		6	V
Ambient Temperature	Tamb	0		70	°C
Storage Temperature	Tstor	-40		105	°C

Note: Use beyond the maximum ratings may cause a reliability degradation of the DC/DC converter or may permanently damage the device.

- The enable pin performs two functions, remote on/off and programmable under voltage lockout. The factory set UVLO point is 4.25V typical, but can be adjusted upward with the addition of a single external resistor located from the enable pin to ground. Turning the converter on and off is accomplished using an open collector/drain device as a switch. The enable pin is internally pulled up to Vin through a 11.5K resistor and the pin's logic is active high.

### Input Specifications

Parameter	Symbol	Min	Typical	Max	Units
Operating Input Voltage	Vin	4.75		15	V
Input Current (Vin=5.0V)	Iin			12	A
Input Current (Vin=12.0V)	Iin			5.1	A
No Load Input Current (Vin=5.0V)	Iin			250	mA
No Load Input Current (Vin=12.0V)	Iin			200	mA
Input Reflected Ripple Current <sup>1</sup>				50	mA <sub>rms</sub>
Input Reflected Ripple Current (P-P) <sup>1</sup>				100	mApk
I <sup>2</sup> t Inrush Current Transient				0.1	A <sup>2</sup> s
Turn On Voltage Threshold <sup>2</sup>			3.1		V
Turn Off Voltage Threshold		2.8	2.9	3	V

Note: Input capacitance 100µF/16V, ESR = 0.03 Ω max at 100kHz @ 25° C.

1. With simulated source impedance of 500nH, 5Hz to 20MHz.

2. UVLO is adjustable by terminating on/off pin to ground per the termination resistance table on page 6.

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### Output Specifications

Parameter	Symbol	Min	Typical	Max	Units
Output Voltage Set Point	Vout	3.29	3.35	3.4	V
Load Regulation (Droop Impedance)	Rout	2	2.5	3	mΩ
Line Regulation Input Voltage 4.75V to 15V			15	25	mV
Line Regulation Input Voltage 12V ±20%			3	10	mV
Regulation Over Temperature 0° - 70° C			10	25	mV
Output Ripple and Noise <sup>1</sup>			25	40	mVp-p
Output Ripple and Noise <sup>1</sup>			10	20	mVrms
Output Current Range	Iout	0		16	A
Output DC Current Limit	Ioutlim	18		22	A
Turn on Time Vin to Vout or on/off to Vout	Ton		8	10	ms
Overshoot at Turn On			0	1	%
Output Capacitance	Cout	100		2200	μF
<b>Transient Response <sup>2</sup> (Vin=5.0V)</b>					
ΔV 50% to 100% of Max Load			150	200	mV
Settling Time	Ts		100	120	μs
ΔV 100% to 50% of Max Load			150	200	mV
Settling Time	Ts		100	120	μs
<b>Transient Response <sup>2</sup> (Vin=12.0V)</b>					
ΔV 50% to 100% of Max Load			120	150	mV
Settling Time	Ts		100	120	μs
ΔV 100% to 50% of Max Load			120	150	mV
Settling Time	Ts		100	120	μs

Note: All specifications are typical at nominal input, full load at 25° C unless otherwise stated.

- 0 - 20MHz BW, 0.1μF ceramic cap on output.
- di/dt = 1A/1μS, Ta = 25° C with a 560μF oscon cap on output.

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### General Specifications

Parameter	Symbol	Min	Typical	Max	Units
Efficiency <sup>1</sup> (Vin=5.0V)	$\eta$	90	91		%
Efficiency <sup>2</sup> (Vin=12.0V)	$\eta$	87.5	89		%
Switching Frequency	Fsw	495	550	605	kHz
Output Voltage Trim Range <sup>3</sup>		90		110	%
Remote Sense Compensation (when option specified)				300	mV
Weight			16		g

1. Vin=5V, full load and Ta=25° C.
2. Vin=12V, full load and Ta=25° C.
3. See graph on page 6.

### Control Specifications

Parameter	Symbol	Min	Typical	Max	Units
Remote On/Off Open Circuit Voltage (Vin=5.0V)	Vouten			2.1	V
Remote On/Off Open Circuit Voltage (Vin=12.0V)	Vouten			5.1	V
Remote On/Off Impedance Limitation (pin pulled up to +Vin)	Renable			11.5	k $\Omega$
Signal Low (Unit Off)		-0.3		0.3	V
Signal High (Unit On)		1.5		5.5	V
Power Good Levels (when option specified)	Vpg				
Signal Low			0.18	0.4	V
Current Sink				4	mA
Signal High (signal is open collector)				5	V
Under Voltage Threshold Vout rising			3.04		V
Under Voltage Threshold Vout falling			2.97		V

Note: On/off pin designed to work with an open collector/drain switch.

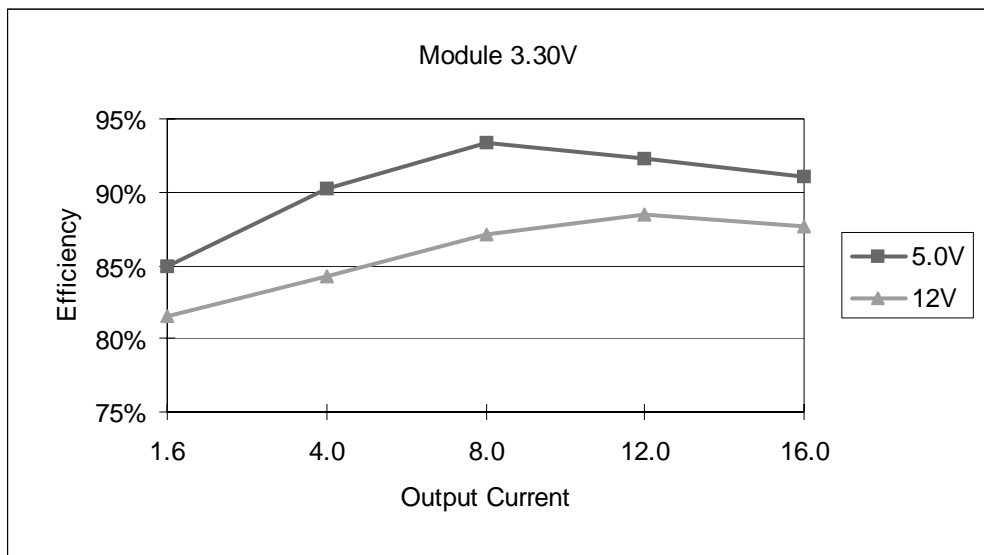
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## Efficiency Data

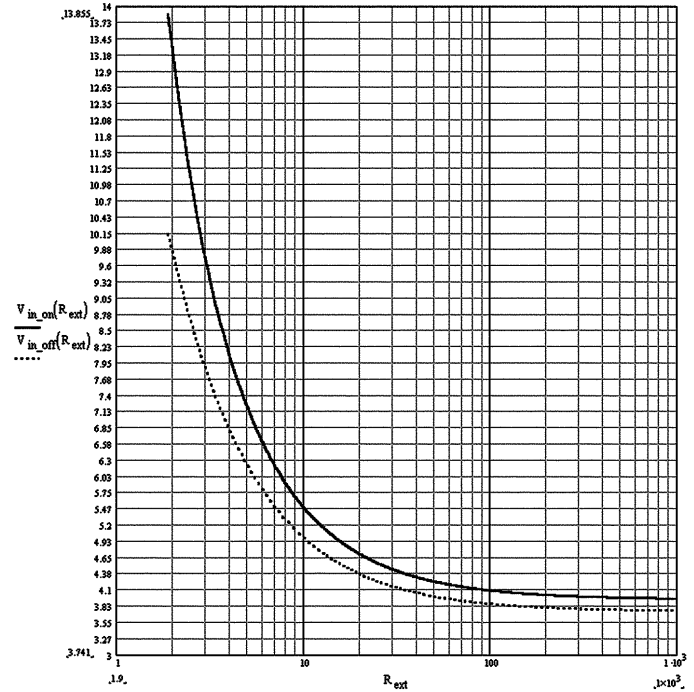


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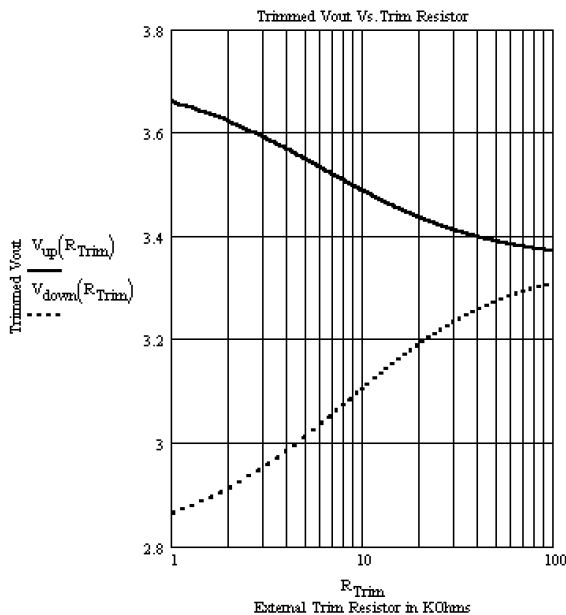
### Termination Resistance

Termination Resistance	Rising Vin UVLO	Falling Vin UVLO
Open Circuit	3.93V	3.73V
21K Ω	4.50V	4.33V
5.90K Ω	6.06V	5.86V
4.99K Ω	6.48V	6.24V
3.06K Ω	8.10V	7.65V
2.61K Ω	9.09V	8.56V
2.10K Ω	10.54V	9.55V
2.05K Ω	10.72V	9.69V

### UVLO



### Output Voltage Trim Range



$$V_{up}(10^0) = 3.35 \quad V_{down}(10^0) = 3.35$$

Trimmed Vout for Various K-Ohm E96 Resistor Values

$V_{up}(30.1) = 3.412$	$V_{down}(30.1) = 3.233$
$V_{up}(12.1) = 3.472$	$V_{down}(12.1) = 3.13$
$V_{up}(10) = 3.488$	$V_{down}(10) = 3.104$
$V_{up}(5.11) = 3.548$	$V_{down}(5.11) = 3.014$
$V_{up}(4.32) = 3.562$	$V_{down}(4.32) = 2.993$
$V_{up}(3.83) = 3.573$	$V_{down}(3.83) = 2.978$
$V_{up}(3.01) = 3.593$	$V_{down}(3.01) = 2.951$
$V_{up}(2.87) = 3.597$	$V_{down}(2.87) = 2.946$
$V_{up}(2.67) = 3.602$	$V_{down}(2.67) = 2.939$
$V_{up}(2.00) = 3.623$	$V_{down}(2.00) = 2.912$
$V_{up}(1.00) = 3.661$	$V_{down}(1.00) = 2.864$
$V_{up}(0) = 3.711$	$V_{down}(0) = 2.805$

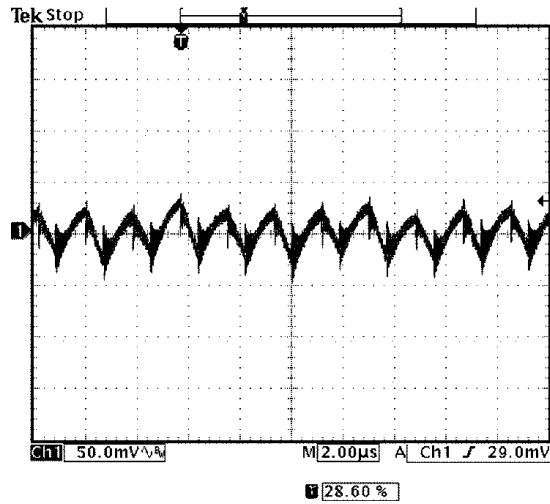
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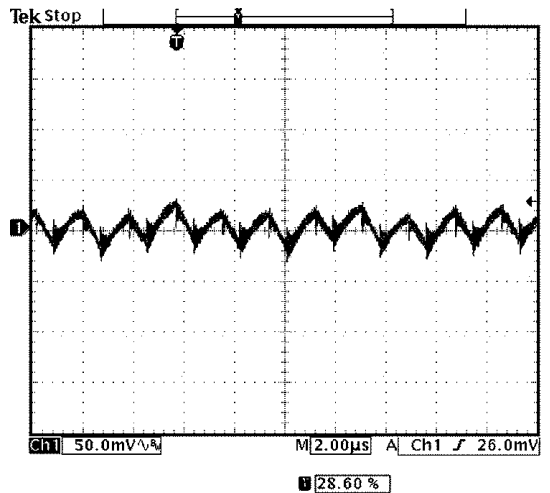


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## Ripple and Noise



Ripple and noise at full load and 12.0Vdc input, and  $T_a=25^\circ\text{C}$

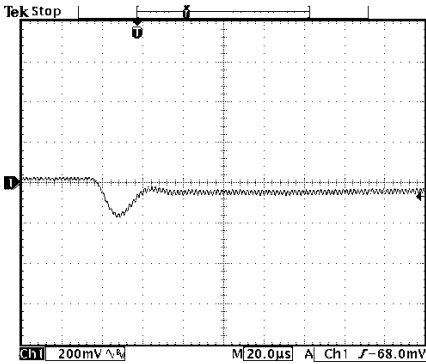


Ripple and noise at full load and 12.0Vdc input, and  $T_a=25^\circ\text{C}$  with 560  $\mu\text{F}$  external cap

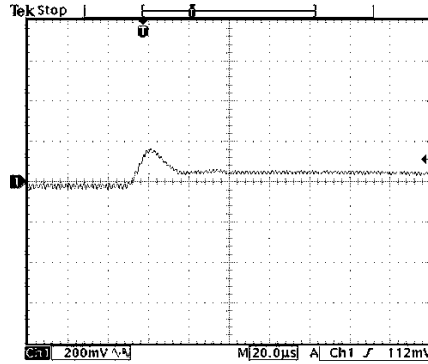
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### Transient Response

Transient response:  $di/dt = 1.0A/\mu S$



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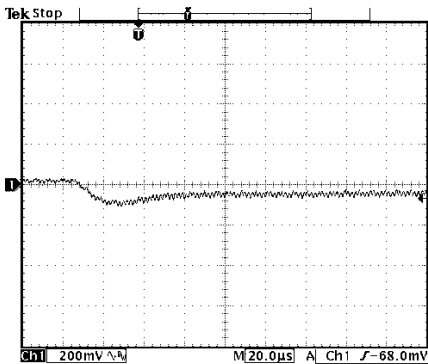


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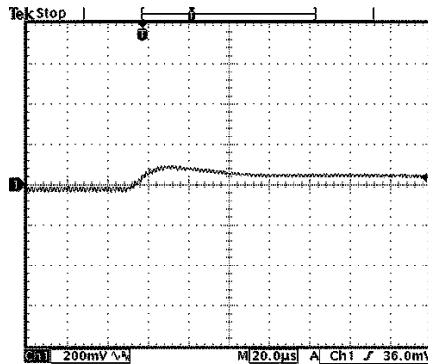
Vout=3.3V  
50% to 100% load transients at 12.0V input and Ta=25° C

Vout=3.3V  
100% to 50% load transients at 12.0V input and Ta=25° C

Transient response:  $di/dt = 1.0A/\mu S$ , external load capacitance 560µF



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Vout=3.3V  
50% to 100% load transients at 12.0V input and Ta=25° C

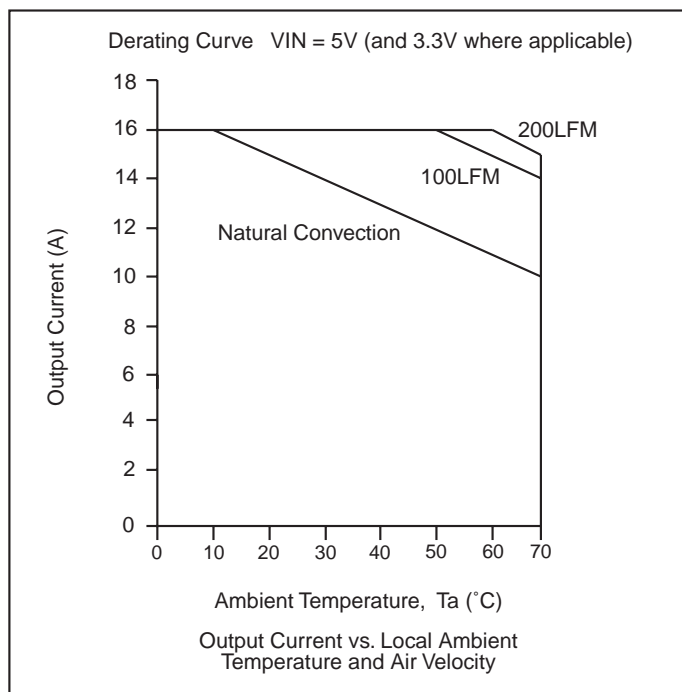
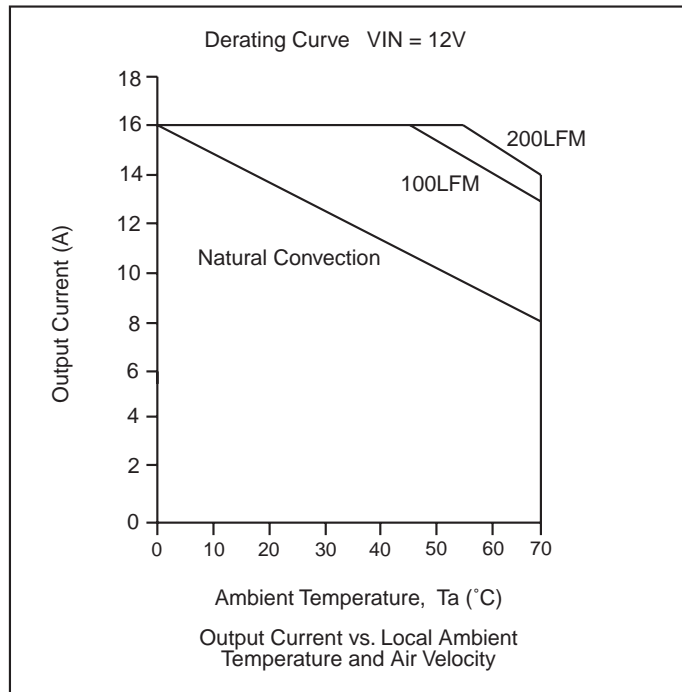
Vout=3.3V  
100% to 50% load transients at 12.0V input and Ta=25° C



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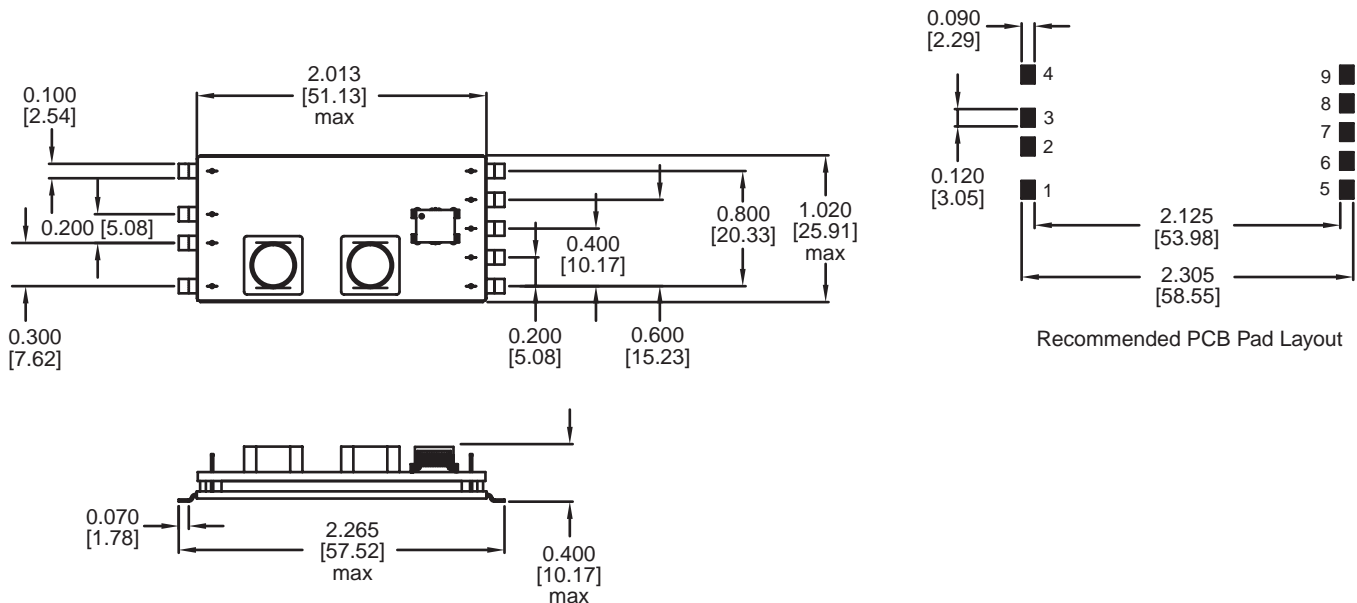
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## Thermal Considerations



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### Mechanical



Dimensions are in inches [millimeters].  
Standard dimension tolerance is  $\pm 0.005$  [0.13] unless otherwise noted.

Pin	Function
1	Control Ground
2	On/Off Control
3 <sup>1</sup>	No Connection
4 <sup>2</sup>	No Connection
5	+Vo
6	Trim
7	Power Ground
8	Power Ground
9	+Vin

1. Pin 3 not used on module S7DC-16D330, used for - sense on S7DC-16D33D and used for power good signal on the S7DC-16D33S module.

2. Pin 4 not used on module S7DC-16D330, used for + sense on both the S7DC-16D33S and S7DC-16D33D modules.

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