



Description

The SP10 series of DC-to-DC converters operate from an input of +12VDC to +48VDC and provide single or dual regulated DC outputs from +/-5 VDC to +/-15 VDC. These units are designed for rugged applications that require a regulated DC power supply capable of operating in environments of high shock, vibration and temperature.

The output voltage tolerance of the series is guaranteed to $\pm 2\%$ at full load. The SP10 series provide a stable output voltage across the entire operating temperature range. Typical drift with temperature is less than 100 ppm/ $^{\circ}$ C. Output noise and ripple is small, typically less than 100mV p-p at full load.

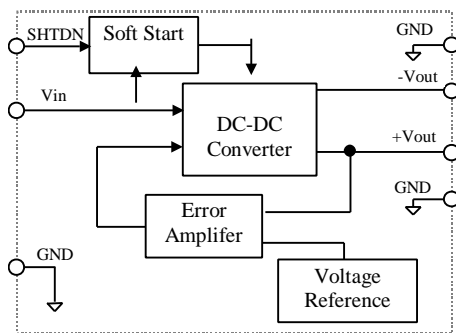


Figure 1

Dual Output Block Diagram

Block diagrams for the dual and single output supplies are shown in Figures 1 and 2. The complete switching supply is housed in a package with mounting tabs.

Features:

- High Operating Temperature (to 175C)
- Compact Design (3.25"L x 1.20"W x 0.67"H).
- High Efficiency (75-80% Typical)
- Encapsulated for High Shock Environments.
- Logic Level Shutdown.
- Wide Input Voltage Range (12.0 to 48.0 Volts)
- Internal Soft Start.

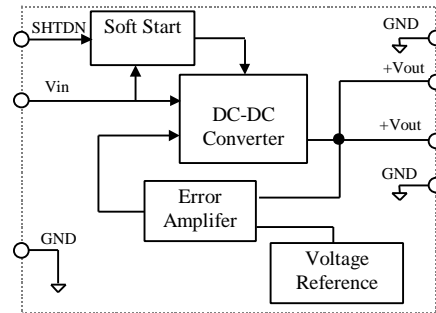


Figure 2

Single Output Block Diagram

The supplies are encapsulated with high temperature potting compounds that enable them to withstand diverse environmental conditions while adding little mechanical stress to the interior components.

Each unit is burned-in and tested over the full operating temperature range prior to shipment and guaranteed against defects.

Mechanical Outline

The supply is packaged in a 3.25 inch long anodized aluminum housing. The cross-section (as shown in the mechanical outline drawing, Figure 13) is 0.647 inch by 1.200 inches.

Safe Operating Range - Loads

Figures 3-5 show the allowable operating load conditions for the SP10. In general, any combination of loads that stays within the constraints of maximum and minimum output power levels is allowed.

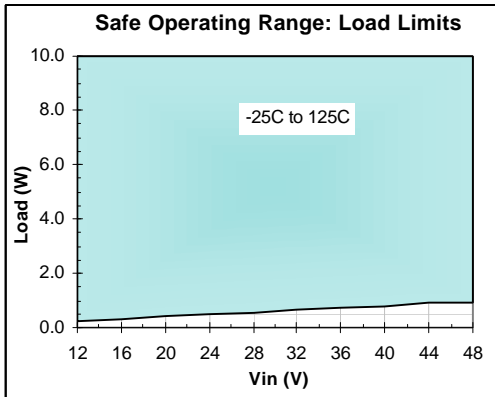


Figure 3
-25C to 125C Safe operating Range.

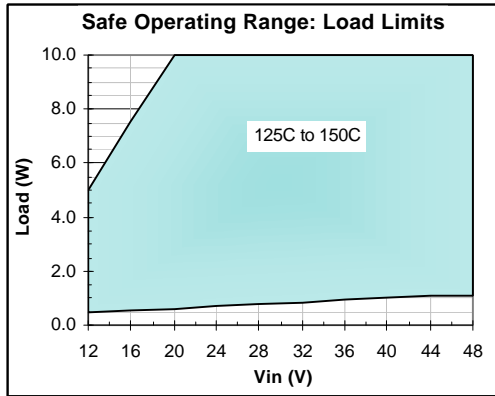


Figure 4
125C to 150C Safe operating Range.

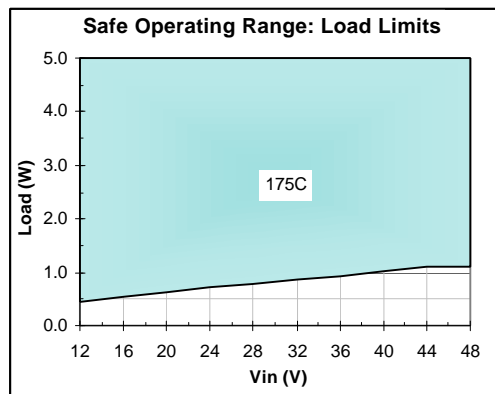


Figure 5
The power capability of the supply derates linearly from 150C to 175C. At 175C the max output power is 5 Watts.

Note that above 150C, maximum output power is linearly derated to 5Watts at 175C. Also note,

for dual output units, that mismatch of loads between the primary and auxiliary outputs, can result in poor cross-regulation (on the auxiliary output - see Figure 10).

Efficiency

Figures 6 and 7 illustrate typical room and high temperature (155C) efficiency performance. Under nominal conditions the efficiency ranges between 75% and 80%.

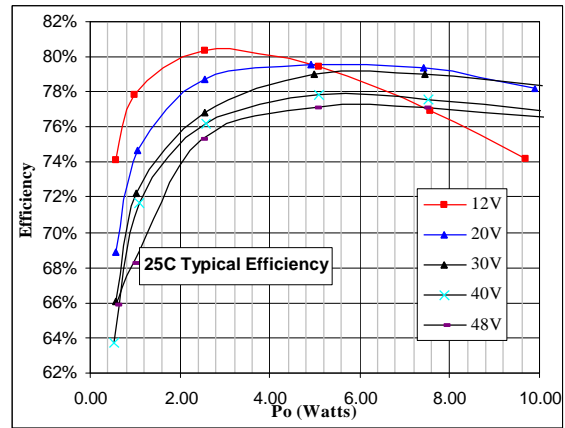


Figure 6
Dual +/-5V supply efficiency curves at 25C.

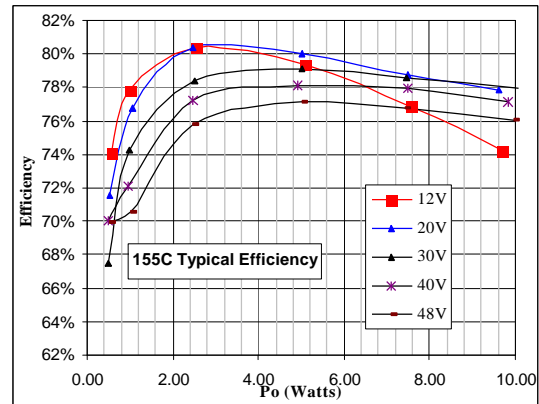


Figure 7
Dual +/-5V supply efficiency curves at 155C.

Ripple

Figures 8 and 9 illustrate typical output voltage ripple performance at half load (i.e. 2.5 watts per output).

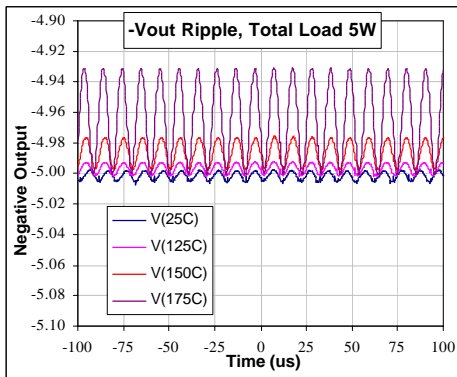


Figure 8

Typical ripple performance (at 25C, 125C, 150C, 175C) on -Vout at half-load conditions ($V_{in} = 30.0Vdc$).

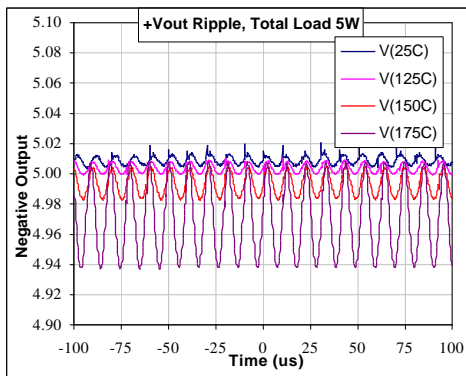


Figure 9

Typical ripple performance (at 25C, 125C, 150C, 175C) on +Vout at half-load conditions ($V_{in} = 30.0Vdc$).

To improve ripple performance the user may elect to add additional output filter capacitance.

Cross-regulation

When using the auxiliary (minus) output of the dual supplies, care should be taken to understand the load conditions.

The auxiliary output will track the primary output as long as the loads are reasonably well matched. Figure 10 shows the effect of load mismatch for the SP10. These results are typical (at 150C). This plot shows, for any allowable load condition, the deviation of the minus output (in %) from the nominal voltage.

For example, with a half load on the plus

output (25 ohms) and minimum load on the minus output (50 ohms), the minus output will be (typically) high by no more than 2.5% (or 5.125V).

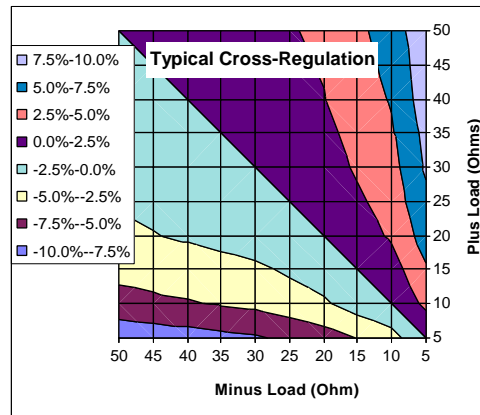


Figure 10

Typical cross-regulation (for the SP10-D-5) at 150C.

Dynamic Performance

Figure 11 illustrates the typical full-load turn-on characteristics. Time from SHUTDOWN going low to full voltage is typically <5 msec.

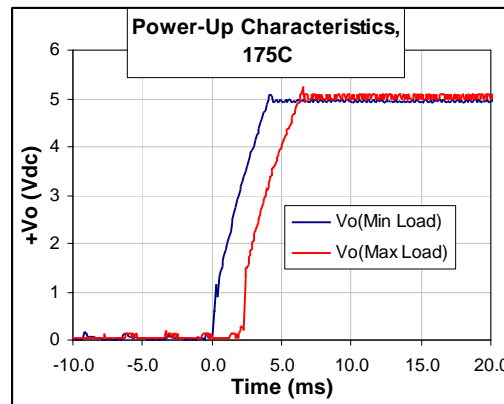


Figure 11

Full load power-up characteristics for the SP10-D-5, at 175V, $V_{in}=30Vdc$, using the logic-level shutdown pin.

Dynamic load performance is shown in Figure 12, illustrating the response of the SP10 to a 10% load change on the primary output. Adding capacitance at the load (i.e. decoupling capacitors) can improve this performance.

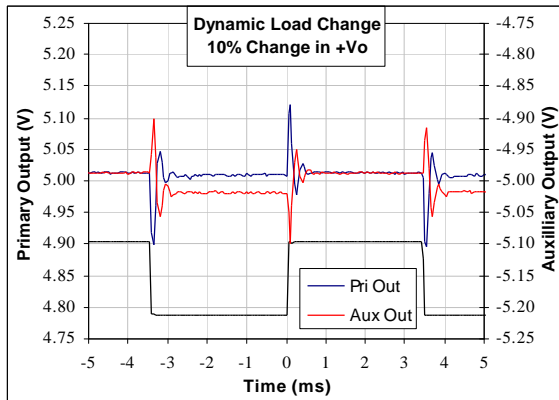


Figure 12

Dynamic load response 10% Load change on +Vo (from 50% to 60% Full Load). Vin=30.0Vdc at 25C.

Application Information

Additional output filtering

The ripple voltage, as illustrated in Figure 10, is small enough for many applications. Additional filtering can improve this performance. Distributed capacitance (i.e. de-coupling capacitors) is always recommended for distributed power systems.

High frequency common-mode noise can be reduced by the use of common-mode chokes (a few turns of the power and return lines through an appropriate high-temperature ferrite material). Separate power and return lines for the dual supply are provided for this reason.

Input filter

A small input inductor (that can handle the large DC currents) can reduce the AC input ripple current if this presents a problem. Additional capacitance at the input can also reduce the AC input ripple current.

Mounting

The case is designed to be mounted to a flat metal surface. Temperature ratings given in this datasheet are for case temperature so it is important that good thermal design practices should be followed to reduce, as much as possible, the case-to-ambient thermal impedance (θ_{CA}).

Specifications: SP10-D-5 and SP10-S-5

Parameter	Test Conditions	Temp	Min	Typ	Max	Units
Output Voltage						
SP10-S/D + V _{out}	Full Load, Vin: 12 to 48V	Full	4.90	5.00	5.10	volts
SP10-D - V _{out}	Full Load, Vin: 12 to 48V	Full	-5.10	-5.00	-4.90	volts
Output Current						
SP10-D (per output)	Full Load, Vin: 12 to 48V	-25 to 150C	(Note 1)		1.0	Amp
SP10-D (per output)	Full Load, Vin: 12 to 48V	150 to 175C	(Note 1)		0.5	Amp
SP10-S	Full Load, Vin: 12 to 48V	-25 to 150C	(Note 1)		2.0	mAmp
SP10-S	Full Load, Vin: 12 to 48V	150 to 175C	(Note 1)		1.0	mAmp
Line Regulation	All Load Conditions	Full		0.0005	0.001	V/V
Load Regulation	V _{in} = 30V, Full to Min load	Full		0.5	1.0	%
Cross Regulation (Note 2)						
Δ(- V _{out}), +Load = 100%	-Load 10% to 100%	Full			10.0	%
Δ(- V _{out}), +Load = 50%	-Load 10% to 100%	Full		5.0	7.5	%
Voltage Drift vs. Temp (Note 3)	Full Load	Full		±0.5	±1.0	%
Output Ripple	V _{in} =30.0, Full Load	25°C		50	100	mV _{pp}
Efficiency	V _{in} =12.0V 50% Load	Full	75%	80%		%
	V _{in} =12.0V 20% Load	Full	70%	75%		%
	V _{in} =30.0V Full Load	Full	75%	80%		%
	V _{in} =30.0V 20% Load	Full	70%	75%		%
	V _{in} =48.0V Full Load	Full	75%	80%		%
	V _{in} =48.0V 20% Load	Full	70%	75%		%
Short Circuit (Note 4)						
Survival Time	V _{in} =30.0V, R _{LOAD} = 0 Ω	25C		TBD		sec
Survival Time	V _{in} =30.0V, R _{LOAD} = 0 Ω	Full		TBD		sec
Input Current	V _{in} =30.0V, R _{LOAD} = 0 Ω	Full		TBD		Amp
Input Requirements						
Supply Voltage	Full Load	25C	12.0		48.0	V
	Half Load	Full	12.0		48.0	V
V _{SHTDWN}						
Threshold		Full	0.5		1.5	V
"Off" Supply Current	V _{in} =30.0V	Full		2.5		mAmp

Notes:

1. See Figures 3-5.
2. Does not apply for single output supplies. See Figure 10.
3. Percent change from room temperature to maximum temperature.
4. Output shorted (either or both outputs for dual supplies).
5. Temperatures shown are for case temperature.

Specifications: SP10-D-12 and SP10-S-12 (Preliminary)

Parameter	Test Conditions	Temp	Min	Typ	Max	Units
Output Voltage						
SP10-S/D + V _{out}	Full Load, Vin: 12 to 48V	Full	11.8	12.0	12.2	volts
SP10-D - V _{out}	Full Load, Vin: 12 to 48V	Full	-12.2	12.0	-11.8	volts
Output Current						
SP10-D (per output)	Full Load, Vin: 12 to 48V	-25 to 150C	(Note 1)		420	mAmp
SP10-D (per output)	Full Load, Vin: 12 to 48V	150 to 175C	(Note 1)		TBD	mAmp
SP10-S	Full Load, Vin: 12 to 48V	-25 to 150C	(Note 1)		830	mAmp
SP10-S	Full Load, Vin: 12 to 48V	150 to 175C	(Note 1)		TBD	mAmp
Line Regulation	All Load Conditions	Full		0.0005	0.001	V/V
Load Regulation	V _{in} = 30V, Full to Min load	Full		0.5	1.0	%
Cross Regulation (Note 2)						
Δ(- V _{out}), +Load = 100%	-Load 10% to 100%	Full			10.0	%
Δ(- V _{out}), +Load = 50%	-Load 10% to 100%	Full		5.0	7.5	%
Voltage Drift vs. Temp (Note 3)	Full Load	Full		±0.5	±1.0	%
Output Ripple	V _{in} =30.0, Full Load	25°C		50	100	mV _{pp}
Efficiency	V _{in} =12.0V 50% Load	Full	75%	80%		%
	V _{in} =12.0V 20% Load	Full	70%	75%		%
	V _{in} =30.0V Full Load	Full	75%	80%		%
	V _{in} =30.0V 20% Load	Full	70%	75%		%
	V _{in} =48.0V Full Load	Full	75%	80%		%
	V _{in} =48.0V 20% Load	Full	70%	75%		%
Short Circuit (Note 4)						
Survival Time	V _{in} =30.0V, R _{LOAD} = 0 Ω	25C		TBD		sec
Survival Time	V _{in} =30.0V, R _{LOAD} = 0 Ω	Full		TBD		sec
Input Current	V _{in} =30.0V, R _{LOAD} = 0 Ω	Full		TBD		Amp
Input Requirements						
Supply Voltage	Full Load	25C	12.0		48.0	V
	Half Load	Full	12.0		48.0	V
V _{SHTDWN}						
Threshold		Full	0.5		1.5	V
"Off" Supply Current	V _{in} =30.0V	Full		2.5		mAmp

Notes:

1. See Figures 3-5.
2. Does not apply for single output supplies. See Figure 10.
3. Percent change from room temperature to maximum temperature.
4. Output shorted (either or both outputs for dual supplies).
5. Temperatures shown are for case temperature.

Specifications: SP10-D-15 and SP10-S-15 (Preliminary)

Parameter	Test Conditions	Temp	Min	Typ	Max	Units
Output Voltage						
SP10-S/D + V _{out}	Full Load, Vin: 12 to 48V	Full	14.7	15.0	15.3	volts
SP10-D - V _{out}	Full Load, Vin: 12 to 48V	Full	-15.3	-15.0	-14.7	volts
Output Current						
SP10-D (per output)	Full Load, Vin: 12 to 48V	-25 to 150C	(Note 1)		420	mAmp
SP10-D (per output)	Full Load, Vin: 12 to 48V	150 to 175C	(Note 1)		TBD	mAmp
SP10-S	Full Load, Vin: 12 to 48V	-25 to 150C	(Note 1)		830	mAmp
SP10-S	Full Load, Vin: 12 to 48V	150 to 175C	(Note 1)		TBD	mAmp
Line Regulation	All Load Conditions	Full		0.0005	0.001	V/V
Load Regulation	V _{in} = 30V, Full to Min load	Full		0.5	1.0	%
Cross Regulation (Note 2)						
Δ(- V _{out}), +Load = 100%	-Load 10% to 100%	Full			10.0	%
Δ(- V _{out}), +Load = 50%	-Load 10% to 100%	Full		5.0	7.5	%
Voltage Drift vs. Temp (Note 3)	Full Load	Full		±0.5	±1.0	%
Output Ripple	V _{in} =30.0, Full Load	25°C		50	100	mV _{pp}
Efficiency	V _{in} =12.0V 50% Load	Full	75%	80%		%
	V _{in} =12.0V 20% Load	Full	70%	75%		%
	V _{in} =30.0V Full Load	Full	75%	80%		%
	V _{in} =30.0V 20% Load	Full	70%	75%		%
	V _{in} =48.0V Full Load	Full	75%	80%		%
	V _{in} =48.0V 20% Load	Full	70%	75%		%
Short Circuit (Note 4)						
Survival Time	V _{in} =30.0V, R _{LOAD} = 0 Ω	25C		TBD		sec
Survival Time	V _{in} =30.0V, R _{LOAD} = 0 Ω	Full		TBD		sec
Input Current	V _{in} =30.0V, R _{LOAD} = 0 Ω	Full		TBD		Amp
Input Requirements						
Supply Voltage	Full Load	25C	12.0		48.0	V
	Half Load	Full	12.0		48.0	V
V _{SHTDWN}						
Threshold		Full	0.5		1.5	V
"Off" Supply Current	V _{in} =30.0V	Full		2.5		mAmp

Notes:

1. See Figures 3-5.
2. Does not apply for single output supplies. See Figure 10.
3. Percent change from room temperature to maximum temperature.
4. Output shorted (either or both outputs for dual supplies).
5. Temperatures shown are for case temperature.

Mechanical/Environmental Specifications:

Parameter	Test Conditions	Temp	Min	Typ	Max	Units
Case Temperature	Operating	Full Load, Vin = 12.0 to 48.0	-	-25	150	°C
	Survival	Full Load, Vin = 12.0 to 48.0	-	-25	175	°C
Shock	1/2 Sine, 5msec Duration	Full			200	G
Vibration	250 Hz Random	Full			25	G
Pressure		Full	0		500	psi
Weight				TBD		gram
Dimensions	Length			3.25		inch
	Height			.647		inch
	Width			1.20		inch

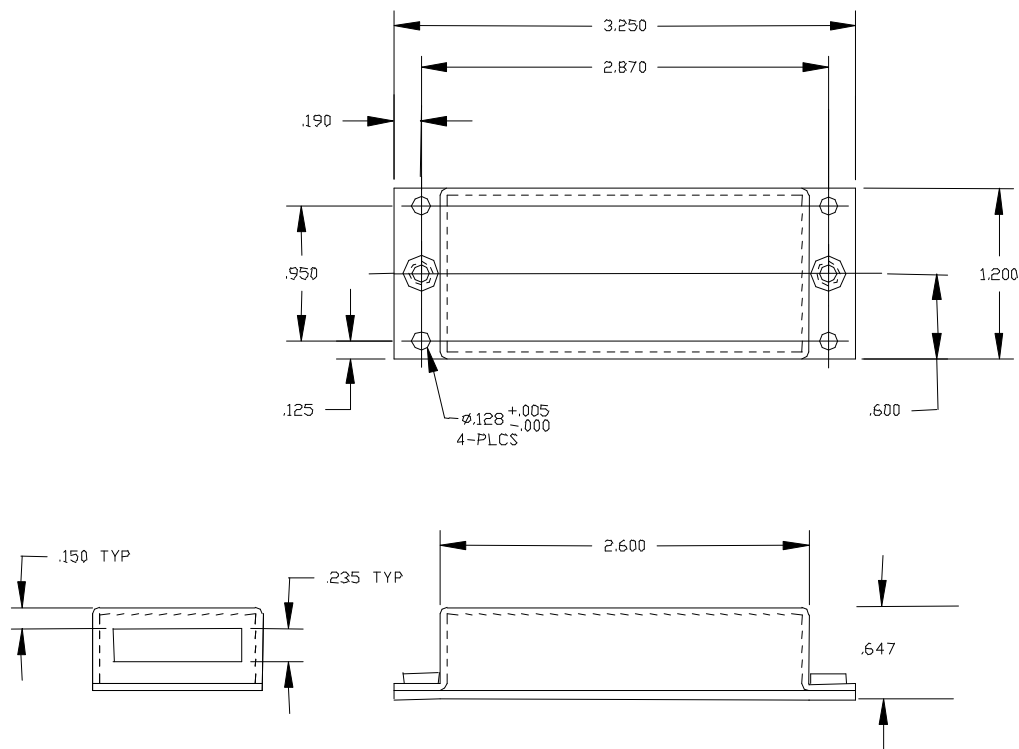
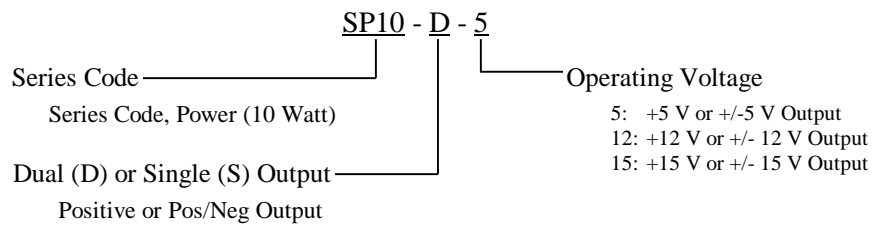


Figure 13
Mechanical Outline Drawing

Ordering Information:



Example: SP10-D-5 is a 10 watt, dual-output, supply with +/-5VDC outputs.

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