

# SDP1108-MFA1

Ultra sensitive transducer with fast response time to measure mass flow in bypass application

**SENSIRION**  
THE SENSOR COMPANY

- Fast response time
- Output correlates with mass flow
- Interchangeable
- High sensitivity below 10 Pa to measure small flows in main pass
- Unsurpassed performance thanks to CMOSens® technology
- Fully calibrated and temperature compensated
- Not sensitive to mounting orientation and vibrations



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## SDP1108-MFA1 Product Summary

The SDP1108-MFA1 is a product of the SDP1000 family. Therefore all SDP1000 specifications apply, if not stated otherwise in this datasheet.

The SDP1108-MFA1 is a differential pressure transducer based on a calorimetric principle. Not alike the SDP1000, it does not compensate for density variations due to temperature. The SDP1108-MFA1 output correlates with mass flow through the transducer when density changes (temperature and ambient pressure variations). This type of calibration makes the SDP1108-MFA1 an ideal sensor to measure mass flow in a bypass application. For additional information, please contact [info@sensirion.com](mailto:info@sensirion.com).

Mounted in a rugged chemically inert PPS housing, the SDP1108-MFA1 sensors feature a unique dynamic range, zero offset and unsurpassed long term stability. This makes it an ideal fit for demanding yet cost sensitive OEM applications in medical equipment. Its leading performance is based on Sensirion's proprietary CMOSens® sensor technology which combines the sensor element with amplification and A/D conversion on one single silicon chip. The SDP1108-MFA1 is robust against pressure bursts or vibrations and shows no sensitivity to the mounting orientation.

# 1 Specifications

 Table 1: Sensor specifications<sup>(1)</sup>

Parameter		SDP1108-MFA1			Unit
		Min	Typ	Max	
Measurement range <sup>(2)</sup>		-500		500	Pa
		-110±20		110±20	mln / min <sup>(6)</sup>
		0.36		3.84	Volts
Null offset		2.05	2.1	2.15	Volts
		-0.3	0	+0.3	mln / min <sup>(6)</sup>
		-0.7	0	+0.7	Pa
Accuracy <sup>(3)</sup>	15 to 500 Pa:			±3.5	% Measured Value <sup>(4)</sup>
	0 to 15 Pa:			±1.0	% Full Scale <sup>(4)</sup>
	-500 to 0 Pa:			±4.0	% Full Scale <sup>(4)</sup>
Null shift <sup>(7)</sup> due to temperature variation [5 to 55°C]		-0.015		+0.015	Volts
		-0.1		+0.1	mln / min <sup>(6)</sup>
		-0.2		+0.2	Pa
Temperature error of span [5 to 23°C]			±0.2	±0.4	% Measured Value/°C <sup>(4,8)</sup>
Temperature error of span [23 to 55°C]			±0.1	±0.2	% Measured Value/°C <sup>(4,8)</sup>
Repeatability	81 to 500 Pa:			±0.5	% Measured Value <sup>(4)</sup>
	-80 to 80 Pa:			±0.3	% Full Scale <sup>(4)</sup>
	-500 to -81 Pa:			±0.5	% Measured Value <sup>(4)</sup>
Null drift per year		-0.3	0	+0.3	Pa / year
		-0.13	0	+0.13	mln / min <sup>(6)</sup>
Resolution	± [0 to 150 Pa]:	0.08	0.1	0.2	Pa
		0.04	0.05	0.1	mln / min <sup>(6)</sup>
	± [151 to 350 Pa]:	0.2	0.5	1.5	Pa
		0.1	0.17	0.35	mln / min <sup>(6)</sup>
	± [351 to 500 Pa]:	1.5	2.2	3	Pa
		0.3	0.4	0.6	mln / min <sup>(6)</sup>
Response time <sup>(5)</sup>		6.6	8.0	10.1	ms
Cut off frequency		17	20	24	Hz
Number of capillaries			2		

<sup>(1)</sup> Calibration conditions apply unless otherwise noted: 23°C and  $p_{\text{absolute}} = 966 \text{ mbar}$ , dry air,  $V_{\text{DD}} = 5.0 \text{ V}$

<sup>(2)</sup> See figure 1

<sup>(3)</sup> Include deviations due to linearity, hysteresis, repeatability.

<sup>(4)</sup> Specified in mVolts:

% measured value = (SDP1108-MFA1 voltage output -2.1) / (SDP1108-MFA1 typical voltage output from Figure1 -2.1)

1 % full scale = 1% \* 3.84 Volts = 0.0384 Volts

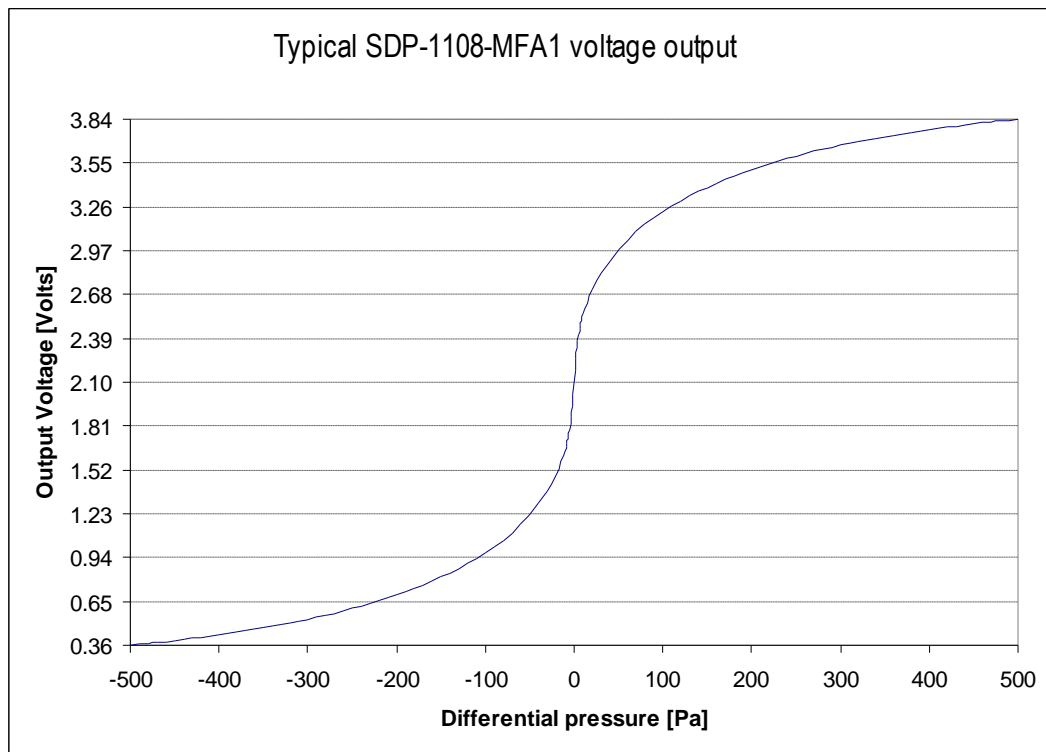
<sup>(5)</sup> Tau= 0 to 63%, filter response time = 8ms, CMOSens® chip update rate = 2ms

<sup>(6)</sup> mln / min = norm milliliter per minute = 1 ml @ 0°C and 1013mBar (32°F and 14.69 Psi); flow specifications are for reference only

<sup>(7)</sup> Null shift due to temperature variations is additional to null offset

<sup>(8)</sup> For example: At 33°C, you need to add  $0.2\% * (33^\circ - 23^\circ) = 2\%$  measured value

Figure 1:



DP [Pa]	Output [Volts]	DP [Pa]	Output [Volts]	DP [Pa]	Output [Volts]	DP [Pa]	Output [Volts]	DP [Pa]	Output [Volts]	DP [Pa]	Output [Volts]
-500	0.361	-310	0.519	-110	0.935	0	2.100	110	3.265	310	3.681
-490	0.367	-290	0.531	-100	0.972	1	2.177	120	3.300	320	3.693
-480	0.372	-280	0.544	-90	1.013	2	2.254	130	3.332	330	3.705
-470	0.378	-270	0.558	-80	1.057	3	2.331	140	3.362	340	3.716
-460	0.384	-260	0.572	-70	1.106	4	2.382	150	3.390	350	3.726
-450	0.391	-250	0.587	-60	1.161	5	2.419	160	3.416	360	3.736
-440	0.398	-240	0.602	-50	1.223	6	2.452	170	3.441	370	3.746
-430	0.398	-240	0.619	-40	1.295	7	2.480	180	3.464	380	3.755
-420	0.405	-230	0.636	-30	1.381	8	2.505	190	3.486	390	3.764
-410	0.412	-220	0.654	-20	1.491	9	2.528	200	3.507	400	3.772
-400	0.420	-210	0.673	-10	1.650	10	2.550	210	3.527	410	3.780
-390	0.428	-200	0.693	-9	1.672	20	2.709	220	3.546	420	3.788
-380	0.436	-190	0.714	-8	1.695	30	2.819	230	3.564	430	3.795
-370	0.445	-180	0.736	-7	1.720	40	2.905	240	3.581	440	3.802
-360	0.454	-170	0.759	-6	1.748	50	2.977	250	3.598	450	3.809
-350	0.464	-160	0.784	-5	1.781	60	3.039	260	3.613	460	3.816
-340	0.474	-150	0.810	-4	1.818	70	3.094	270	3.628	470	3.822
-330	0.484	-140	0.838	-3	1.869	80	3.143	280	3.642	480	3.828
-320	0.495	-130	0.868	-2	1.946	90	3.187	290	3.656	490	3.833
-320	0.507	-120	0.900	-1	2.023	100	3.228	300	3.669	500	3.839

Typical SDP-1108-MFA1 voltage output under calibration conditions (23°C and  $p_{\text{absolute}} = 966$  mbar, dry air,  $V_{\text{DD}} = 5.0$  V)

Table 2: Additional sensor specifications.

Media	Air, N <sub>2</sub> – for other gases contact Sensirion AG.		
Operating conditions: - Temperature - Humidity	-10 °C ... +60 °C / 14°F ... 140 °F non-condensing ( 0 to 99%RH)		
Ambient storage conditions <sup>1</sup>	-40 °C ... +80 °C / -40°F ... 176 °F		
Position sensitivity	below resolution		
Proof pressure (short term)	1 bar (14.5 PSI)		
Burst pressure capability	2 bar (29 PSI)		
Weight	14 g		
Protection class	IP 00		
Wetted materials	Glass (silicon nitride, silicon oxide), Silicon, PPS (Polyphenylene Sulfide), PEEK (Polyetheretherketone), FR4, Silicone as static sealing, Epoxy, Gold		
Electromagnetic compatibility	EN 61000-4-2	Air discharge (ESD)	± 2 kV
	EN 61000-4-3	High frequency electromagnetic radiation (HF)	3 V/m
	EN 61000-4-4	Fast transients (burst)	± 4 kV
Lead free	ROHS compatible		

<sup>(1)</sup> For maximum 2 weeks

### 1.1 Temperature Compensation

Not alike the SDP1000, the SDP1108-MFA1 does not compensate for density variations due to temperature. The SDP1108-MFA1 output correlates with mass flow when density changes (temperature and ambient pressure variations).

However the SDP1108-MFA1 sensors feature a sophisticated built-in temperature compensation circuit to compensate for artifacts. The temperature is measured on the CMOSens chip by means of a PTAT bandgap reference temperature sensor. Its data is fed into a compensation circuit which is also integrated on the CMOSens<sup>®</sup> sensor chip (MEMS 3<sup>rd</sup> generation). Therefore no temperature correction is needed.

### 1.2 Altitude Correction

Not alike the SDP1000 output, the SDP1108-MFA1 output correlates with mass flow when density

changes (temperature and ambient pressure variations). Therefore no altitude correction is needed.

### 1.3 How do I measure volume flow?

It is possible to measure volume flow in a bypass application with the SDP1108-MFA1. For additional details, please contact [info@sensirion.com](mailto:info@sensirion.com).

### 1.4 Relative humidity correction

The SDP1108-MFA1 is calibrated for dry air. Like any other mass flow sensors, the output of the SDP1108-MFA1 is affected by humidity, because humid air has a smaller density and viscosity, but a higher heat capacity.

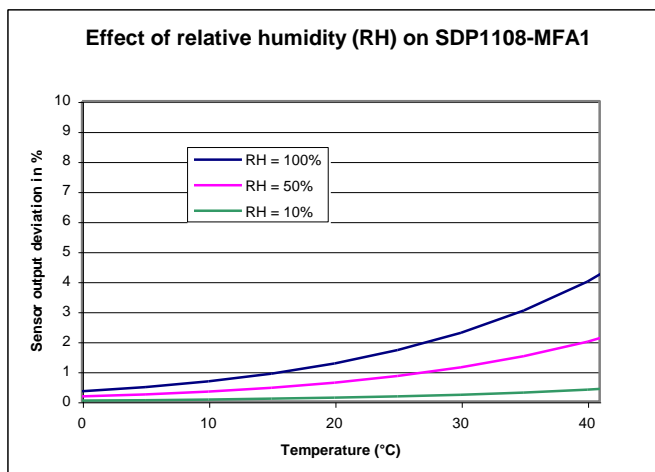
The effective differential pressure equals the output of the transducer times a correction factor ( $C_{Factor}$ ):

$$Dp_{effective} = Dp_{transducer} * CF \text{ Correction Factor}$$

The correction factor is described in the table below:

Relative Humidity	T= 20°C	T= 30°C	T= 40°C
100%	$C_{Factor}=0.988$	$C_{Factor}=0.978$	$C_{Factor}=0.962$
50%	$C_{Factor}=0.994$	$C_{Factor}=0.989$	$C_{Factor}=0.980$
10%	$C_{Factor}=0.999$	$C_{Factor}=0.998$	$C_{Factor}=0.996$

For applications in bypass, Sensirion AG recommends to characterize the complete system for different relative humidity and temperature, as changing surrounding conditions also influence the ration main pass / bypass.



## 2 Electrical Specifications

### 2.1 Power Supply

The SDP1000 / SDP2000 differential pressure sensors require a stable voltage supply of 5 V. Influence of the supply voltage variation on the offset and the sensitivity are given in Table 4.

### 2.2 Voltage Output

The resistive load at the output pin should be larger than 20 kOhm. The capacitive load at the output pin must not be larger than 200 pF. If the design shows a larger capacity at the output pin an additional resistor is required in series at the output (e.g. 620 Ohm). For additional information on ESD protection, please contact [info@sensirion.com](mailto:info@sensirion.com).

Table 3: Electrical characteristics.

Parameter	Conditions	Min.	Typ.	Max.	Units
Power Supply Voltage $V_{DD}$		4.75	5.0	5.25	VDC
Operating Current	5 V, no load		5.5	7	mA
Output capacitive load $C_{load}$			20	200	pF
Recommended load $R_{load}$		20	100	$\infty$	k $\Omega$

Table 4: Power supply dependency of voltage output.

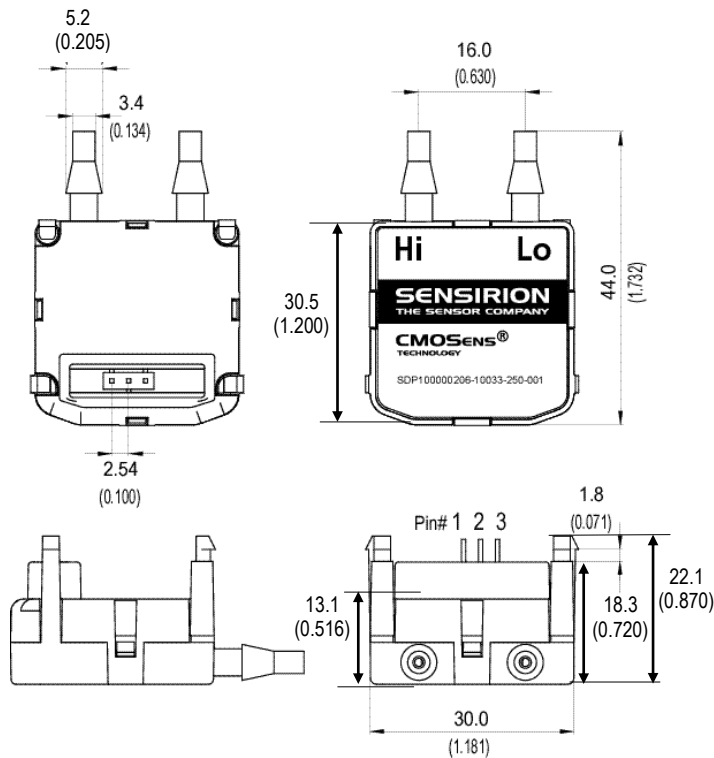
$V_{out} = V_{supply} / 5V * V_{normal}$	
$V_{out}$	sensor voltage output with any supply voltage (in a range between 4.75 and 5.25 V)
$V_{normal}$ :	sensor voltage output with a supply voltage of 5V
$V_{supply}$ :	Supply voltage

### 3 Physical Dimensions and Mounting Information

#### 3.1 Housing

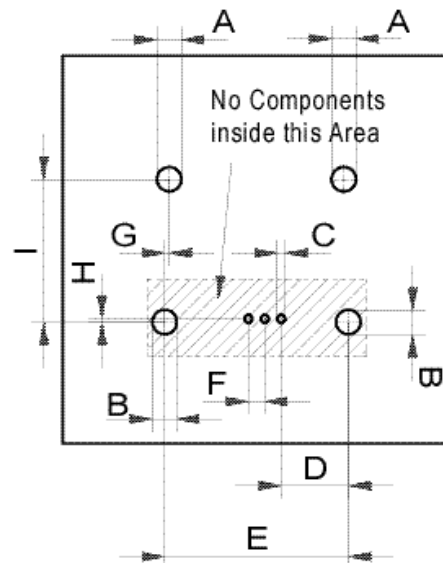
The SDP1108-MFA1 transducer is mounted in chemically inert PPS housing. The rugged package has been designed to withstand overpressures of at least 1 bar (14.5 PSI). Burst pressure is > 2 bar (29 PSI)

The physical dimensions and mounting information is given in Figure 4 and 5. The SDP1108-MFA1 comes with a private label including Sensirion's product number for quality purposes. Sensirion's name does not appear on the label.



Pin#	Function
1	VDD (5 Vdc)
2	Ground
3	OUT (0.25...4 Vdc)

Figure 4: Pin out and physical dimensions in mm (inch). The drawing is not to scale.



Dim.	[mm]	[inch]	[mil]
A	3.00	0.118	118
B	3.30	0.130	130
C	1.20	0.047	47
D	10.20	0.402	402
E	28.20	1.110	1110
F	2.54	0.100	100
G	0.60	0.024	24
H	0.50	0.020	20
I	22.70	0.894	894

Figure 5: SDP1108-MFA1 PCB footprint. The drawing is not to scale.

#### 3.2 Soldering Instructions

The SDP1108-MFA1 sensor can be wave soldered. Direct reflow soldering is not recommended since it may affect the accuracy.

If reflow soldering is required Sensirion recommends to use an SMD connector (e.g. type Samtec SSM-

103-L-SV) and to mount the SDP1108-MFA1 after soldering.

## 4 Ordering Information

When ordering please refer to the following part names and article numbers. For the latest product information and local distributor check out Sensirion's website on <http://www.sensirion.com>

Part Name	Article Number
SDP1108-MFA1	1-100333-03

## 5 Revision History

Date	Revision	Changes
April 26 <sup>th</sup> 2006	0.1 (Preliminary)	
May 8 <sup>th</sup> 2006	0.2 (Preliminary)	Added influence of humidity
May 15 <sup>th</sup> 2006	0.3 (Preliminary)	Added specs in ml/min for reference
June 21 <sup>st</sup> 2006	0.4 (Preliminary)	Private labels, improved definition of accuracy, null offset and shift, voltage dependency
July 5 <sup>th</sup> 2006	0.5 (Preliminary)	Accuracy in voltage, revised data for clarification
July 24 <sup>th</sup> 2006	0.6 (Preliminary)	Figure 1, Table "Typical SDP-1108-MFA1 voltage output" corrected values for 0 to 100 Pa.
August 2 <sup>nd</sup> 2006	0.7 (Preliminary)	Added influence of humidity at 10%Rh and recommendation to characterize complete system.
August 3 <sup>rd</sup> 2006	0.8 (Preliminary)	Added definition of full scale and chart for 10% Rh
August 10 <sup>th</sup> 2006	1.0	Version renamed on request from Michael Kane
May 10 <sup>th</sup> 2007	1.1	Update Table 4 (power supply dependence)
May 2014	2	Updated Product Number and last page.
May 2014	2.1	Minor updates

## Important Notices

### Warning, personal injury

**Do not use this product as safety or emergency stop devices or in any other application where failure of the product could result in personal injury (including death). Do not use this product for applications other than its intended and authorized use. Before installing, handling, using or servicing this product, please consult the datasheet and application notes. Failure to comply with these instructions could result in death or serious injury.**

If the Buyer shall purchase or use SENSIRION products for any unintended or unauthorized application, Buyer shall defend, indemnify and hold harmless SENSIRION and its officers, employees, subsidiaries, affiliates and distributors against all claims, costs, damages and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if SENSIRION shall be allegedly negligent with respect to the design or the manufacture of the product.

### ESD Precautions

The inherent design of this component causes it to be sensitive to electrostatic discharge (ESD). To prevent ESD-induced damage and/or degradation, take customary and statutory ESD precautions when handling this product.

See application note "Handling Instructions" for more information.

### Warranty

SENSIRION warrants solely to the original purchaser of this product for a period of 12 months (one year) from the date of delivery that this product shall be of the quality, material and workmanship defined in SENSIRION's published specifications of the product. Within such period, if proven to be defective, SENSIRION shall repair and/or replace this product, in SENSIRION's discretion, free of charge to the Buyer, provided that:

- notice in writing describing the defects shall be given to SENSIRION within fourteen (14) days after their appearance;
- such defects shall be found, to SENSIRION's reasonable satisfaction, to have arisen from SENSIRION's faulty design, material, or workmanship;
- the defective product shall be returned to SENSIRION's factory at the Buyer's expense; and
- the warranty period for any repaired or replaced product shall be limited to the unexpired portion of the original period.

This warranty does not apply to any equipment which has not been installed and used within the specifications recommended by SENSIRION for the intended and proper use of the equipment. EXCEPT FOR THE WARRANTIES EXPRESSLY SET FORTH HEREIN, SENSIRION MAKES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THE PRODUCT. ANY AND ALL WARRANTIES, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY EXCLUDED AND DECLINED.

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### REACH and RoHS

The SDP1108 Series complies with requirements of the following directives:

- EU Directive 1907/2006/EC concerning Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)
- EU Directive 2002/65/EC on the restriction of certain hazardous substances in electric and electronic equipment (RoHS), OJ01.01.2011



## Headquarters and Subsidiaries

SENSIRION AG  
Laubisruetistr. 50  
CH-8712 Staefa ZH  
Switzerland

phone: +41 44 306 40 00  
fax: +41 44 306 40 30  
[info@sensirion.com](mailto:info@sensirion.com)  
[www.sensirion.com](http://www.sensirion.com)

Sensirion AG (Germany)  
phone: +41 44 927 11 66  
[info@sensirion.com](mailto:info@sensirion.com)  
[www.sensirion.com](http://www.sensirion.com)

Sensirion Inc., USA  
phone: +1 805 409 4900  
[info\\_us@sensirion.com](mailto:info_us@sensirion.com)  
[www.sensirion.com](http://www.sensirion.com)

Sensirion Japan Co. Ltd.  
phone: +81 3 3444 4940  
[info@sensirion.co.jp](mailto:info@sensirion.co.jp)  
[www.sensirion.co.jp](http://www.sensirion.co.jp)

Sensirion Korea Co. Ltd.  
phone: +82 31 337 7700~3  
[info@sensirion.co.kr](mailto:info@sensirion.co.kr)  
[www.sensirion.co.kr](http://www.sensirion.co.kr)

Sensirion China Co. Ltd.  
phone: +86 755 8252 1501  
[info@sensirion.com.cn](mailto:info@sensirion.com.cn)  
[www.sensirion.com.cn](http://www.sensirion.com.cn)

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