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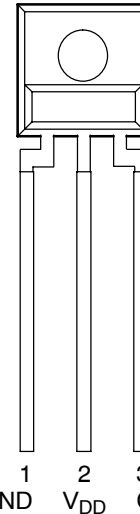
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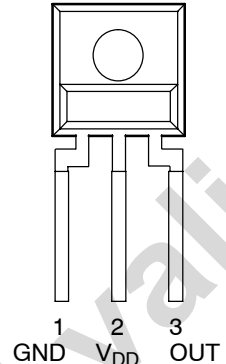
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- Converts Light Intensity to Output Voltage
- Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components
- High Sensitivity
- Single Voltage Supply Operation (2.7 V to 5.5 V)
- Low Noise (200  $\mu$ Vrms Typ to 1 kHz)
- Rail-to-Rail Output
- High Power-Supply Rejection (35 dB at 1 kHz)
- Compact 3-Leaded Plastic Package
- RoHS Compliant (–LF Package Only)

**PACKAGE S**  
**SIDELOOKER**  
**(FRONT VIEW)**



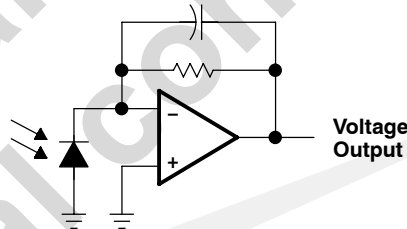
**PACKAGE SM**  
**SURFACE MOUNT**  
**SIDELOOKER**  
**(FRONT VIEW)**



## Description

The TSL257 is a high-sensitivity low-noise light-to-voltage optical converter that combines a photodiode and a transimpedance amplifier on a single monolithic CMOS integrated circuit. Output voltage is directly proportional to light intensity (irradiance) on the photodiode. The TSL257 has a transimpedance gain of 320 M $\Omega$ . The device has improved offset voltage stability and low power consumption and is supplied in a 3-lead clear plastic sidelooker package with an integral lens. When supplied in the lead (Pb) free package, the device is RoHS compliant.

## Functional Block Diagram



## Available Options

DEVICE	T <sub>A</sub>	PACKAGE – LEADS	PACKAGE DESIGNATOR	ORDERING NUMBER
TSL257	0°C to 70°C	3-lead Sidelooker	S	TSL257
TSL257	0°C to 70°C	3-lead Sidelooker — Lead (Pb) Free	S	TSL257–LF
TSL257	0°C to 70°C	3-lead Surface-Mount Sidelooker — Lead (Pb) Free	SM	TSL257SM–LF

## Terminal Functions

TERMINAL NAME	NO.	DESCRIPTION
GND	1	Ground (substrate). All voltages are referenced to GND.
OUT	3	Output voltage
V <sub>DD</sub>	2	Supply voltage

# TSL257 HIGH-SENSITIVITY LIGHT-TO-VOLTAGE CONVERTER

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## Absolute Maximum Ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

Supply voltage, $V_{DD}$ (see Note 1)	6 V
Output current, $I_O$	$\pm 10$ mA
Duration of short-circuit current at (or below) 25°C	5 s
Operating free-air temperature range, $T_A$	–25°C to 85°C
Storage temperature range, $T_{stg}$	–25°C to 85°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds (S Package)	260°C
Reflow solder, in accordance with J-STD-020C or J-STD-020D (SM Package)	260°C

<sup>†</sup> Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: All voltages are with respect to GND.

## Recommended Operating Conditions

	MIN	MAX	UNIT
Supply voltage, $V_{DD}$	2.7	5.5	V
Operating free-air temperature, $T_A$	0	70	°C

## Electrical Characteristics at $V_{DD} = 5$ V, $T_A = 25^\circ\text{C}$ , $\lambda_p = 470$ nm, $R_L = 10$ k $\Omega$ (unless otherwise noted) (see Notes 2 and 3)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_D$ Dark voltage	$E_e = 0$	0		15	mV
$V_{OM}$ Maximum output voltage swing	$V_{DD} = 4.5$ V, No Load		4.49		V
	$V_{DD} = 4.5$ V, $R_L = 10$ k $\Omega$	4	4.2		
$V_O$ Output voltage	$E_e = 1.54$ $\mu\text{W}/\text{cm}^2$ , $\lambda_p = 470$ nm, Note 5	1.6	2	2.4	V
$\alpha_{VD}$ Temperature coefficient of dark voltage ( $V_D$ )	$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$		–15		$\mu\text{V}/^\circ\text{C}$
$N_e$ Irradiance responsivity	$\lambda_p = 428$ nm, see Notes 4 and 8		1.18		$\text{V}/(\mu\text{W}/\text{cm}^2)$
	$\lambda_p = 470$ nm, see Notes 5 and 8		1.30		
	$\lambda_p = 565$ nm, see Notes 6 and 8		1.58		
	$\lambda_p = 645$ nm, see Notes 7 and 8		1.68		
PSRR Power supply rejection ratio	$f_{ac} = 100$ Hz, see Note 9		55		dB
	$f_{ac} = 1$ kHz, see Note 9		35		dB
$I_{DD}$ Supply current	$E_e = 1.54$ $\mu\text{W}/\text{cm}^2$ , $\lambda_p = 470$ nm, Note 5		1.9	3.5	mA

NOTES: 2. Measured with  $R_L = 10$  k $\Omega$  between output and ground.

3. Optical measurements are made using small-angle incident radiation from a light-emitting diode (LED) optical source.

4. The input irradiance is supplied by a GaN/SiC light-emitting diode with the following characteristics: peak wavelength  $\lambda_p = 428$  nm, spectral halfwidth  $\Delta\lambda_{1/2} = 65$  nm.

5. The input irradiance is supplied by an InGaN light-emitting diode with the following characteristics: peak wavelength  $\lambda_p = 470$  nm, spectral halfwidth  $\Delta\lambda_{1/2} = 35$  nm.

6. The input irradiance is supplied by a GaP light-emitting diode with the following characteristics: peak wavelength  $\lambda_p = 565$  nm, spectral halfwidth  $\Delta\lambda_{1/2} = 28$  nm.

7. The input irradiance is supplied by an AlGaAs light-emitting diode with the following characteristics: peak wavelength  $\lambda_p = 645$  nm, spectral halfwidth  $\Delta\lambda_{1/2} = 25$  nm.

8. Irradiance responsivity is characterized over the range  $V_O = 0.1$  V to 4.5 V. The best-fit straight line of Output Voltage  $V_O$  versus Irradiance  $E_e$  over this range will typically have a positive extrapolated  $V_O$  value for  $E_e = 0$ .

9. Power supply rejection ratio PSRR is defined as  $20 \log (\Delta V_{DD}(f)/\Delta V_O(f))$  with  $V_{DD}(f = 0) = 5$  V and  $V_O(f = 0) = 2$  V.

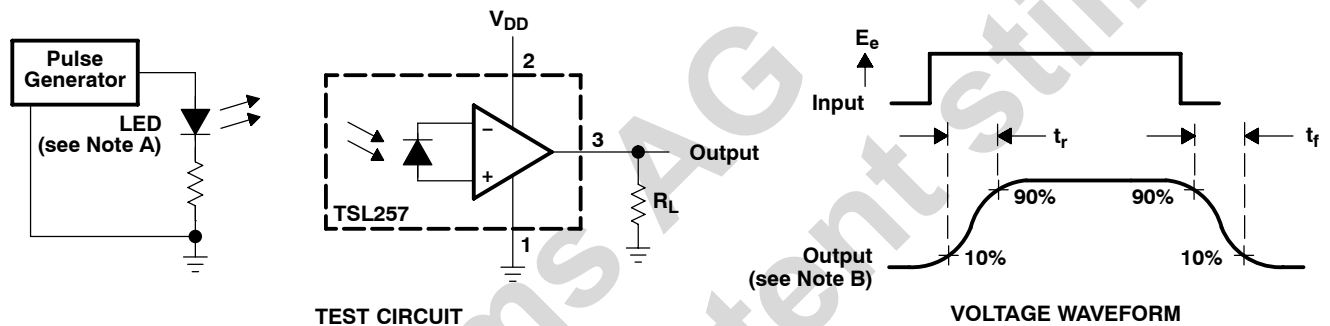


**Switching Characteristics at  $V_{DD} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ ,  $\lambda_p = 470\text{ nm}$ ,  $R_L = 10\text{ k}\Omega$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_r$ Output pulse rise time, 10% to 90% of final value	See Note 10 and Figure 1		160	250	$\mu\text{s}$
$t_f$ Output pulse fall time, 10% to 90% of final value	See Note 10 and Figure 1		150	250	$\mu\text{s}$
$t_s$ Output settling time to 1% of final value	See Note 10 and Figure 1		330		$\mu\text{s}$
Integrated noise voltage	$f = \text{dc to } 1\text{ kHz}$ $E_e = 0$		200		$\mu\text{V}_{\text{rms}}$
$V_n$ Output noise voltage, rms	$f = 10\text{ Hz}$ $E_e = 0$		6		$\mu\text{V}/\sqrt{\text{Hz}}_{\text{rms}}$
	$f = 100\text{ Hz}$ $E_e = 0$		6		
	$f = 1\text{ kHz}$ $E_e = 0$		7		

NOTE 10: Switching characteristics apply over the range  $V_O = 0.1\text{ V}$  to  $4.5\text{ V}$ .

### PARAMETER MEASUREMENT INFORMATION



- NOTES: A. The input irradiance is supplied by a pulsed InGaN light-emitting diode with the following characteristics:  $\lambda_p = 470\text{ nm}$ ,  $t_r < 1\text{ }\mu\text{s}$ ,  $t_f < 1\text{ }\mu\text{s}$ .  
 B. The output waveform is monitored on an oscilloscope with the following characteristics:  $t_r < 100\text{ ns}$ ,  $Z_i \geq 1\text{ M}\Omega$ ,  $C_i \leq 20\text{ pF}$ .

**Figure 1. Switching Times**

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## TYPICAL CHARACTERISTICS

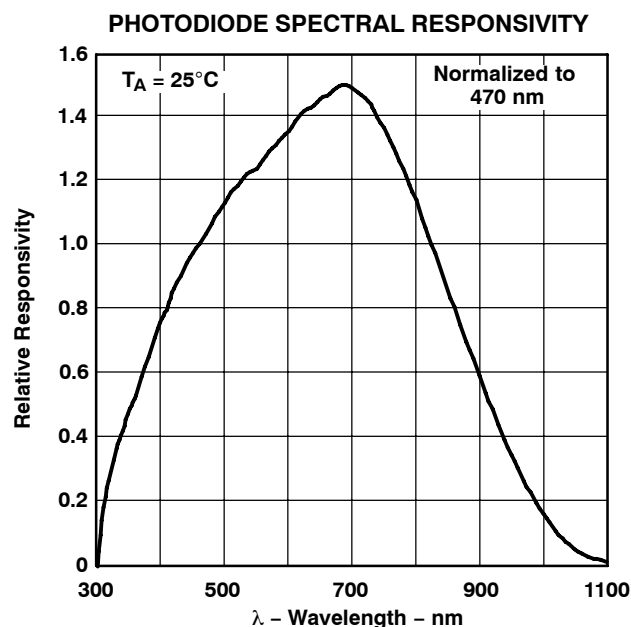


Figure 2

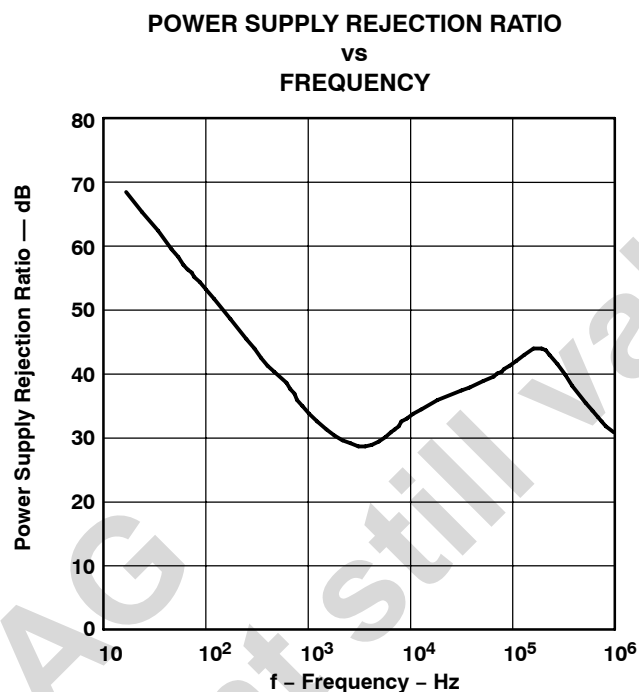


Figure 3

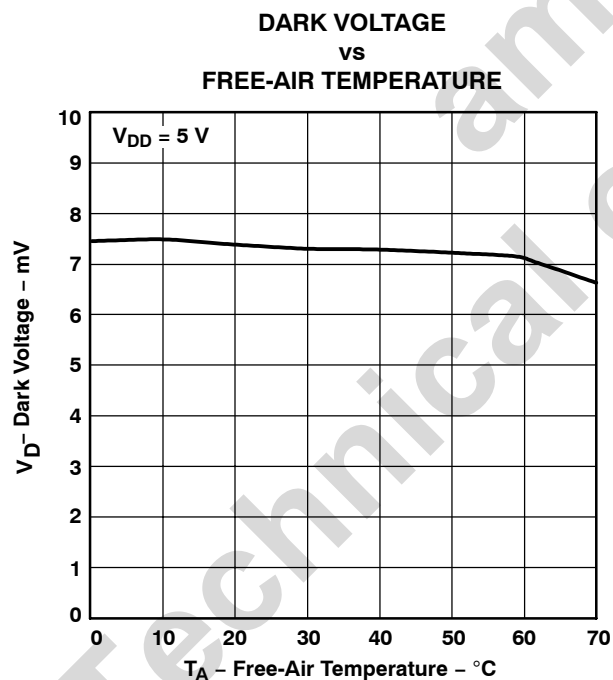


Figure 4

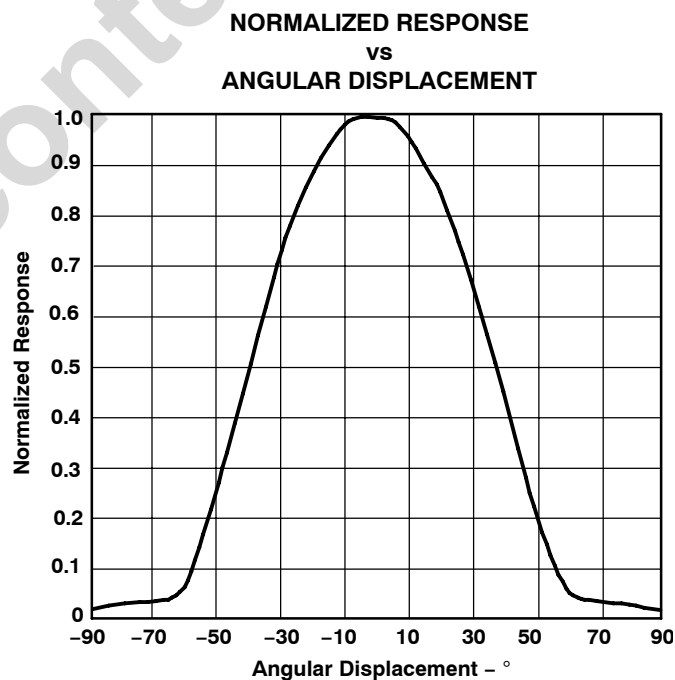


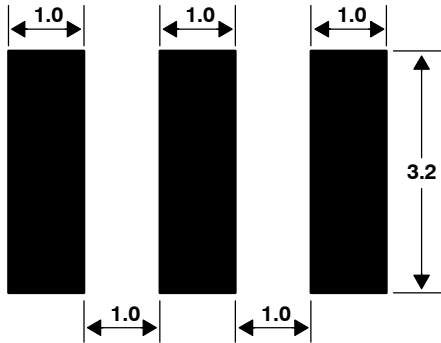
Figure 5



## APPLICATION INFORMATION

### PCB Pad Layout

Suggested PCB pad layout guidelines for the SM surface mount package are shown in Figure 6.



- NOTES: A. All linear dimensions are in millimeters.  
B. This drawing is subject to change without notice.

**Figure 6. Suggested SM Package PCB Layout**

**TSL257**  
**HIGH-SENSITIVITY**  
**LIGHT-TO-VOLTAGE CONVERTER**

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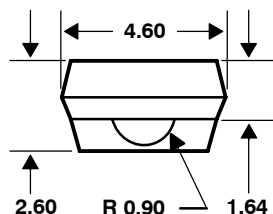
**MECHANICAL DATA**

The device is supplied in a clear plastic three-lead sidelooker through-hole package (S).

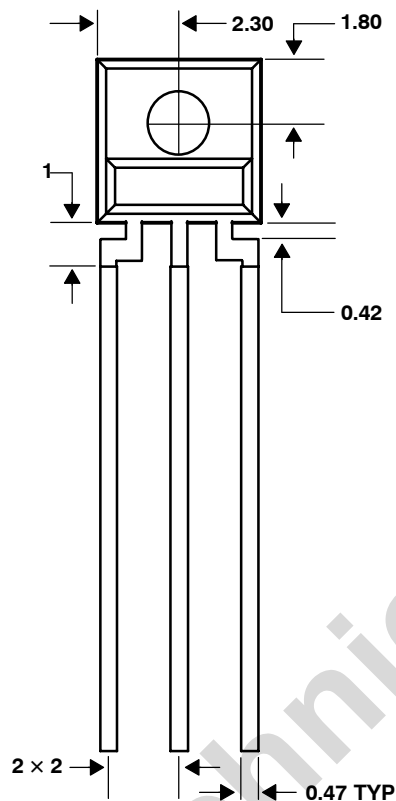
**PACKAGE S**

**PLASTIC SINGLE-IN-LINE SIDE-LOOKER PACKAGE**

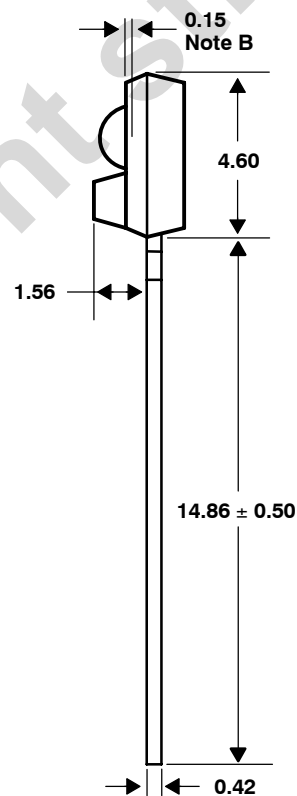
**TOP VIEW**



**FRONT VIEW**



**SIDE VIEW**



Lead Free  
Available

- NOTES: A. All linear dimensions are in millimeters; tolerance is  $\pm 0.25$  mm unless otherwise stated.  
 B. Dimension is to center of lens arc, which is located below the package face.  
 C. The integrated photodiode active area is round with a typical diameter of 0.75 mm and is typically located in the center of the lens and 0.97 mm below the top of the lens surface.  
 D. Index of refraction of clear plastic is 1.55.  
 E. Lead finish for TSL257: solder dipped, 63% Sn/37% Pb. Lead finish for TSL257-LF: solder dipped, 100% Sn.  
 F. This drawing is subject to change without notice.

**Figure 7. Package S — Single-In-Line Side-Looker Package Configuration**

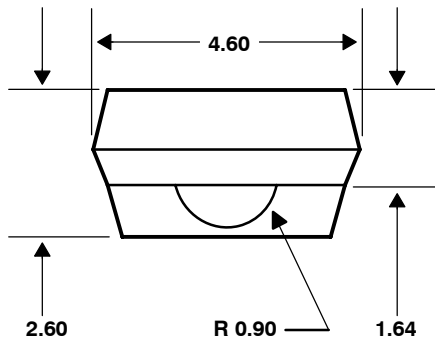


## MECHANICAL DATA

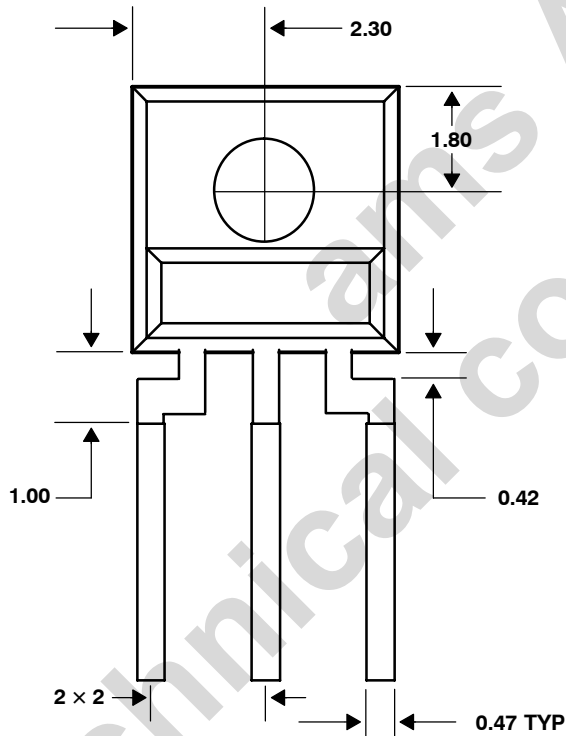
### PACKAGE SM

### PLASTIC SURFACE MOUNT SIDE-LOOKER PACKAGE

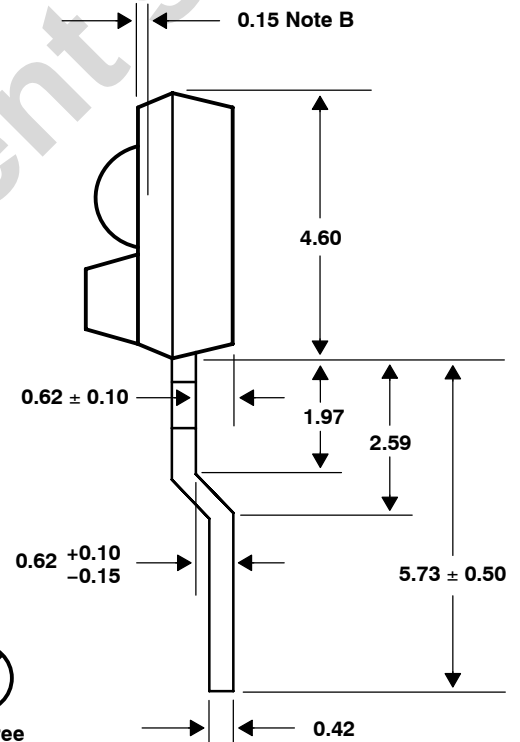
#### TOP VIEW



#### FRONT VIEW



#### SIDE VIEW



- NOTES: A. All linear dimensions are in millimeters; tolerance is  $\pm 0.25$  mm unless otherwise stated.  
 B. Dimension is to center of lens arc, which is located below the package face.  
 C. The integrated photodiode active area is typically located in the center of the lens and 0.97 mm below the top of the lens surface.  
 D. Index of refraction of clear plastic is 1.55.  
 E. Lead finish for TSL257SM-LF: solder dipped, 100% Sn.  
 F. This drawing is subject to change without notice.

**Figure 8. Package SM — Surface Mount Side-Looker Package Configuration**



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