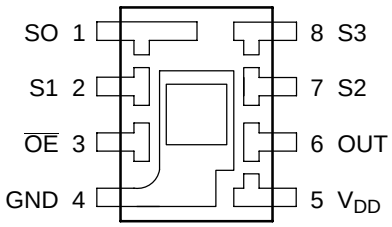
- 光强到频率的高分辨率转换
- 可编程色彩和全量程输出频率
- 与微控制器直接通信
- 单电源工作**(2.7 V至5.5 V)**
- **Power Down Feature**
- **50 kHz**时的非线性误差通常为**0.2%**
- **Stable 200 ppm/°C Temperature Coefficient**
- **Low-Profile Surface-Mount Package**

SOIC PACKAGE
(TOP VIEW)

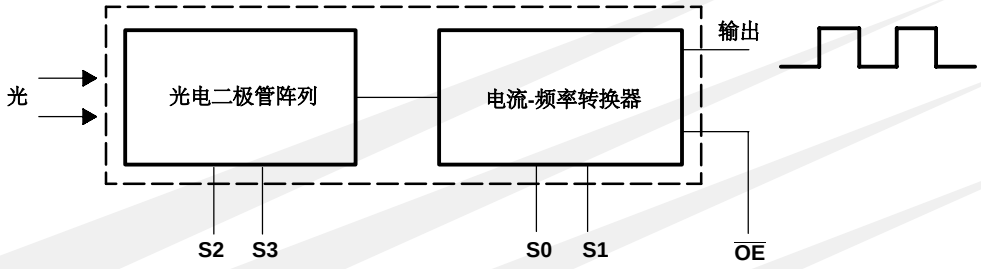


描述

TCS230可编程彩色光频转换器在单片CMOS集成电路上集成了可配置硅光电二极管和电流频率转换器。输出为方波(占空比50%)，频率与光强(辐照度)成正比。满量程输出频率可以通过两个控制输入引脚按三个预设值之一进行定标。数字输入和数字输出允许直接接口到微控制器或其他逻辑电路。输出使能($\overline{OE}$)将输出置于高阻抗状态，以实现微控制器输入线的多单元共享。

The light-to-frequency converter reads an 8 x 8 array of photodiodes. Sixteen photodiodes have blue filters, 16 photodiodes have green filters, 16 photodiodes have red filters, and 16 photodiodes are clear with no filters. The four types (colors) of photodiodes are interdigitated to minimize the effect of non-uniformity of incident irradiance. All 16 photodiodes of the same color are connected in parallel and which type of photodiode the device uses during operation is pin-selectable. Photodiodes are 120 µ m x 120 µ m in size and are on 144-µ m centers.

功能框图



Texas Advanced Optoelectronic Solutions Inc.
800 Jupiter Road, Suite 205 • Plano, TX 75074 • (972) 673-0759
www.taosinc.com

管脚功能

TERMINAL NAME	TERMINAL NO.	I/O	DESCRIPTION
GND	4		电源地。所有电压均以GND为基准。
$\overline{OE}$	3	I	启用 f_o (低电平0有效).
OUT	6	O	输出频率(f_o).
S0, S1	1, 2	I	输出频率缩放选择输入。
S2, S3	7, 8	I	光电二极管类型选择输入。
V_{DD}	5		供电电压

Table 1. Selectable Options

S0	S1	输出频率缩放比例 (f_o)		S2	S3	光电二极管类型（颜色）	
L 0	L 0	Power down （应该是不输出，0）		L	L	红	
L 0	H 1	2%		L	H	蓝	
H 1	L 0	20%		H	L	Clear (no filter)	清除(无过滤器)
H 1	H 1	100%		H	H	绿	

Available Options

DEVICE	T_A	PACKAGE - LEADS	PACKAGE DESIGNATOR	ORDERING NUMBER
TCS230	- 25°C to 85° C	SOIC-8	D	TCS230D

Absolute Maximum Ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, V_{DD} (see Note 1) . . . . . 6 V
Input voltage range, all inputs, V_I . . . . . - 0.3 V to V_{DD} + 0.3 V
Operating free-air temperature range, T_A . . . . . 0°C to 70°C
Storage temperature range . . . . . - 25°C to 85°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°C

† 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 voltage values are with respect to GND.

Recommended Operating Conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{DD}		2.7	5	5.5	V
High-level input voltage, V_{IH}	V_{DD} = 2.7 V to 5.5 V	2		V_{DD}	V
Low-level input voltage, V_{IL}	V_{DD} = 2.7 V to 5.5 V	0		0.8	V
Operating free-air temperature range, T_A		0		70	°C

Electrical Characteristics at T_A = 25°C, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH}	High-level output voltage	I_{OH} = -4 mA	4	4.5		V
V_{OL}	Low-level output voltage	I_{OL} = 4 mA		0.25	0.40	V
I_{IH}	High-level input current				5	µA
I_{IL}	Low-level input current				5	µA
I_{DD}	Supply current	Power-on mode		2	3	mA
		Power-down mode		7	15	µA
	Full-scale frequency (See Note 2)	S0 = H, S1 = H	500	600		kHz
		S0 = H, S1 = L	100	120		kHz
		S0 = L, S1 = H	10	12		kHz
	Temperature coefficient of output frequency	$\lambda \leq$ 700 nm, -25°C $\leq T_A \leq$ 70°C		±200		ppm/°C
k_{SVS}	Supply voltage sensitivity	V_{DD} = 5 V ±10%		±0.5		%/V

NOTE 2: Full-scale frequency is the maximum operating frequency of the device without saturation.

Operating Characteristics at V_{DD} = 5 V, T_A = 25°C, S0 = H, S1 = H (unless otherwise noted) (See Notes 3, 4, 5, 6, and 7).

PARAMETER		TEST CONDITIONS	CLEAR PHOTODIODE S2 = H, S3 = L			BLUE PHOTODIODE S2 = L, S3 = H			GREEN PHOTODIODE S2 = H, S3 = H			RED PHOTODIODE S2 = L, S3 = L			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
f_O	Output frequency	E_e = 45.6 µW/cm^2, λ_p = 470 nm	16	20	24	11.2	16.4	21.6							kHz
		E_e = 39.2 µW/cm^2, λ_p = 524 nm	16	20	24				8	13.6	19.2				kHz
		E_e = 32.8 µW/cm^2, λ_p = 635 nm	16	20	24							14	19	24	kHz
		E_e = 0		2	12		2	12		2	12		2	12	Hz
R_e	Irradiance responsivity (Note 8)	λ_p = 470 nm		439			360			88			31		Hz/ (µW/ cm^2)
		λ_p = 524 nm		510			189			347			46		
		λ_p = 565 nm		548			49			318			110		
		λ_p = 635 nm		610			30			37			579		
	Saturation Irradiance (Note 9)	λ_p = 470 nm		1370			1670								µW/ cm^2
		λ_p = 524 nm		1180						1730					
		λ_p = 565 nm		1090						1890					
		λ_p = 635 nm		980									1040		
R_v	Illuminance responsivity (Note 10)	λ_p = 470 nm		585			480			117			41		Hz/ lx
		λ_p = 524 nm		98			36			67			9		
		λ_p = 565 nm		92			8			53			18		
		λ_p = 635 nm		407			20			25			386		
	Nonlinearity (Note 11)	f_O = 0 to 5 kHz		±0.1 %			±0.1 %			±0.1 %			±0.1 %		% F.S.
		f_O = 0 to 50 kHz		±0.2 %			±0.2 %			±0.2 %			±0.2 %		% F.S.
		f_O = 0 to 500 kHz		±0.5 %			±0.5 %			±0.5 %			±0.5 %		% F.S.
	Recovery from power down			100			100			100			100		µs
	Response time to output enable ($\overline{OE}$)			100			100			100			100		ns

NOTES: 3. Optical measurements are made using small-angle incident radiation from a light-emitting diode (LED) optical source.
4. The 470 nm input irradiance is supplied by an InGaN light-emitting diode with the following characteristics: peak wavelength λ_p = 470 nm, spectral halfwidth $\Delta\lambda_{1/2}$ = 35 nm, and luminous efficacy = 75 lm/W.
5. The 524 nm input irradiance is supplied by an InGaN light-emitting diode with the following characteristics: peak wavelength λ_p = 524 nm, spectral halfwidth $\Delta\lambda_{1/2}$ = 47 nm, and luminous efficacy = 520 lm/W.
6. The 565 nm input irradiance is supplied by a GaP light-emitting diode with the following characteristics: peak wavelength λ_p = 565 nm, spectral halfwidth $\Delta\lambda_{1/2}$ = 28 nm, and luminous efficacy = 595 lm/W.
7. The 635 nm input irradiance is supplied by a AlInGaP light-emitting diode with the following characteristics: peak wavelength λ_p = 635 nm, spectral halfwidth $\Delta\lambda_{1/2}$ = 17 nm, and luminous efficacy = 150 lm/W.
8. Irradiance responsivity R_e is characterized over the range from zero to 5 kHz.
9. Saturation irradiance = (full-scale frequency)/(irradiance responsivity).
10. Illuminance responsivity Rv is calculated from the irradiance responsivity by using the LED luminous efficacy values stated in notes 4, 5, and 6 and using 1 lx = 1 lm/m^2.
11. Nonlinearity is defined as the deviation of f_O from a straight line between zero and full scale, expressed as a percent of full scale.

典型特性

光电二极管光谱响应率

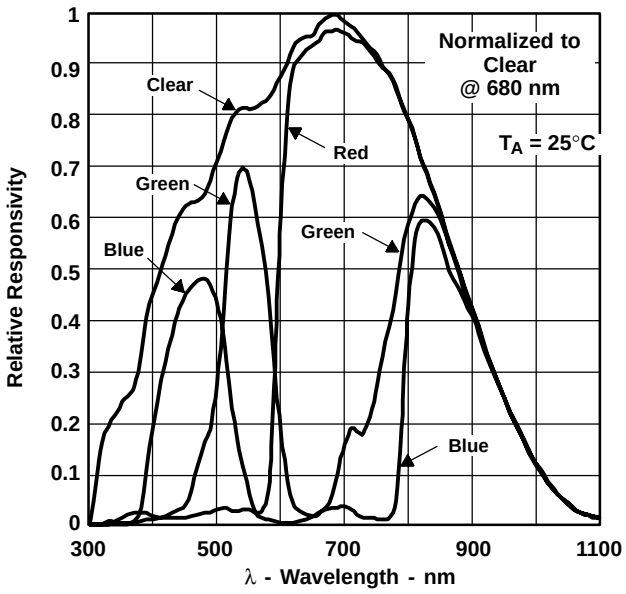


Figure 1

外置HOYA CM500滤光片的光电二极管光谱响应度

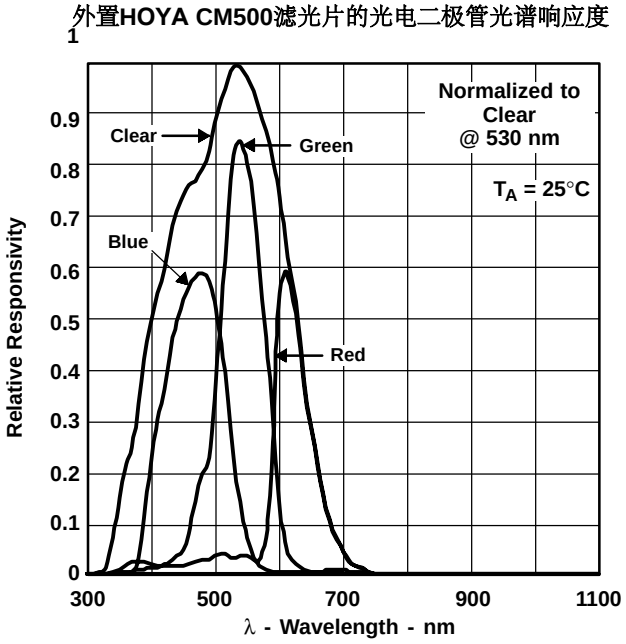


Figure 2

应用信息

Power supply considerations

Power-supply lines must be decoupled by a 0.01-µF to 0.1-µF capacitor with short leads mounted close to the device package.

Input interface

A low-impedance electrical connection between the device $\overline{OE}$ pin and the device GND pin is required for improved noise immunity.

Output interface

The output of the device is designed to drive a standard TTL or CMOS logic input over short distances. If lines greater than 12 inches are used on the output, a buffer or line driver is recommended.

光电二极管类型(颜色)选择

设备使用的光电二极管类型(蓝色、绿色、红色或透明)由两个逻辑输入 s2和 s3控制(参见 表 1)。

输出频率缩放

输出频率调节由两个逻辑输入S0和S1控制。内部光频转换器产生固定脉宽的脉冲串。缩放是通过将转换器的脉冲串输出内部连接到一系列分频器来实现的。分频输出为占空比为50%的方波，其相对频率值分别为100%、20%和2%。因为输出频率的分频是通过对主内频率的脉冲进行计数来完成的，所以最终输出周期表示主频率的多个周期的平均值。

输出缩放计数器寄存器在 s0，s1，s2，s3和 $\overline{oe}$ 线的任何转换之后的主频率的下一个脉冲时被清除。输出在主频的下一个后续脉冲上升，开始一个新的有效周期。这最小化了输入行上的变化和产生的新输出周期之间的时间延迟。对输入规划变化或辐照度阶跃变化的响应时间为一个新频率周期加上1us。按比例输出通过选定的比例因子改变全比例频率和暗比例频率。

频率缩放功能允许输出范围优化的各种测量技术。缩小的输出可以用在只有较慢的频率计数器可用的地方，例如低成本的微控制器，或者使用周期测量技术的地方。

测量频率

接口和测量技术的选择取决于所需的分辨率和数据采集速率。为了获得最大的数据采集速率，使用了周期测量技术。

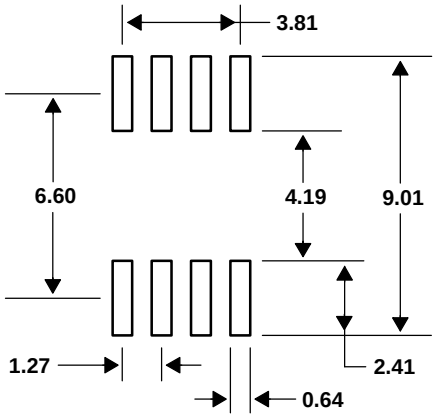
输出数据可以以两倍于输出频率的速率收集，或者以每微秒一个数据点的速率收集全规模输出。周期测量需要使用一个快速的参考时钟与可用的分辨率直接相关的参考时钟频率。输出缩放可以用来提高给定时钟频率的分辨率，或者在光输入改变时最大化分辨率。周期测量用于测量快速变化的光能级或对恒定光源进行非常快速的测量。

最大的分辨率和精度可以获得使用频率测量，脉冲积累，或积分技术。频率测量提供了平均出随机或高频率变化(抖动)所产生的噪声在光信号的额外好处。分辨率主要受可用的计数器寄存器和允许的测量时间的限制。频率测量非常适合慢变或恒定的光线水平和阅读平均光线水平在短时间内。积分(脉冲在很长一段时间内的积累)可用于测量曝光量，即某一区域在给定时间内出现的光量。

APPLICATION INFORMATION

PCB pad layout

Suggested PCB pad layout guidelines for the D package are shown in Figure 3.

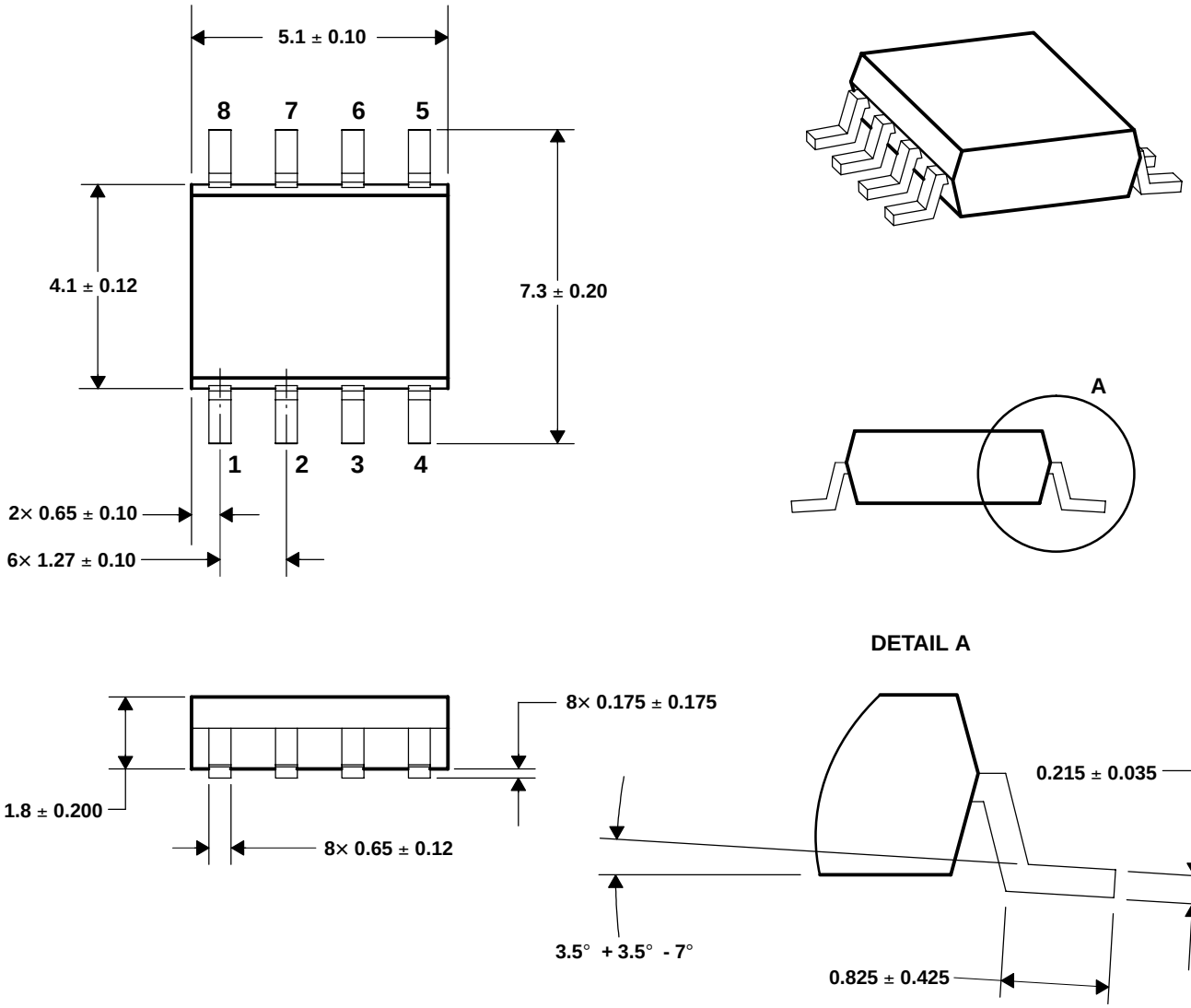


NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.

Figure 3. Suggested *D* Package PCB Layout

MECHANICAL INFORMATION

PACKAGE D **PLASTIC SMALL-OUTLINE PACKAGE**



NOTES: A. All linear dimensions are in millimeters.
B. Package is molded with an electrically nonconductive clear plastic compound having an index of refraction of 1.55.
C. Actual product will vary within the mechanical tolerances shown on this specification. Designs for use of this product MUST allow for the data sheet tolerances.
D. Pin 4 (GND) is mechanically connected to the die mount pad.
E. The 8 × 8 photodiode array area is 1.15 mm × 1.15 mm (1.33 sq. mm).
F. This drawing is subject to change without notice.

Figure 4. TCS230 Mechanical Specifications

PRODUCTION DATA — information in this document is current at publication date. Products conform to specifications in accordance with the terms of Texas Advanced Optoelectronic Solutions, Inc. standard warranty. Production processing does not necessarily include testing of all parameters.

NOTICE

Texas Advanced Optoelectronic Solutions, Inc. (TAOS) reserves the right to make changes to the products contained in this document to improve performance or for any other purpose, or to discontinue them without notice. Customers are advised to contact TAOS to obtain the latest product information before placing orders or designing TAOS products into systems.

TAOS assumes no responsibility for the use of any products or circuits described in this document or customer product design, conveys no license, either expressed or implied, under any patent or other right, and makes no representation that the circuits are free of patent infringement. TAOS further makes no claim as to the suitability of its products for any particular purpose, nor does TAOS assume any liability arising out of the use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages.

TEXAS ADVANCED OPTOELECTRONIC SOLUTIONS, INC. PRODUCTS ARE NOT DESIGNED OR INTENDED FOR USE IN CRITICAL APPLICATIONS IN WHICH THE FAILURE OR MALFUNCTION OF THE TAOS PRODUCT MAY RESULT IN PERSONAL INJURY OR DEATH. USE OF TAOS PRODUCTS IN LIFE SUPPORT SYSTEMS IS EXPRESSLY UNAUTHORIZED AND ANY SUCH USE BY A CUSTOMER IS COMPLETELY AT THE CUSTOMER'S RISK.