

LIGHT-TO-FREQUENCY CONVERTER

SOES003 – AUGUST 1990 – REVISED JUNE 1991

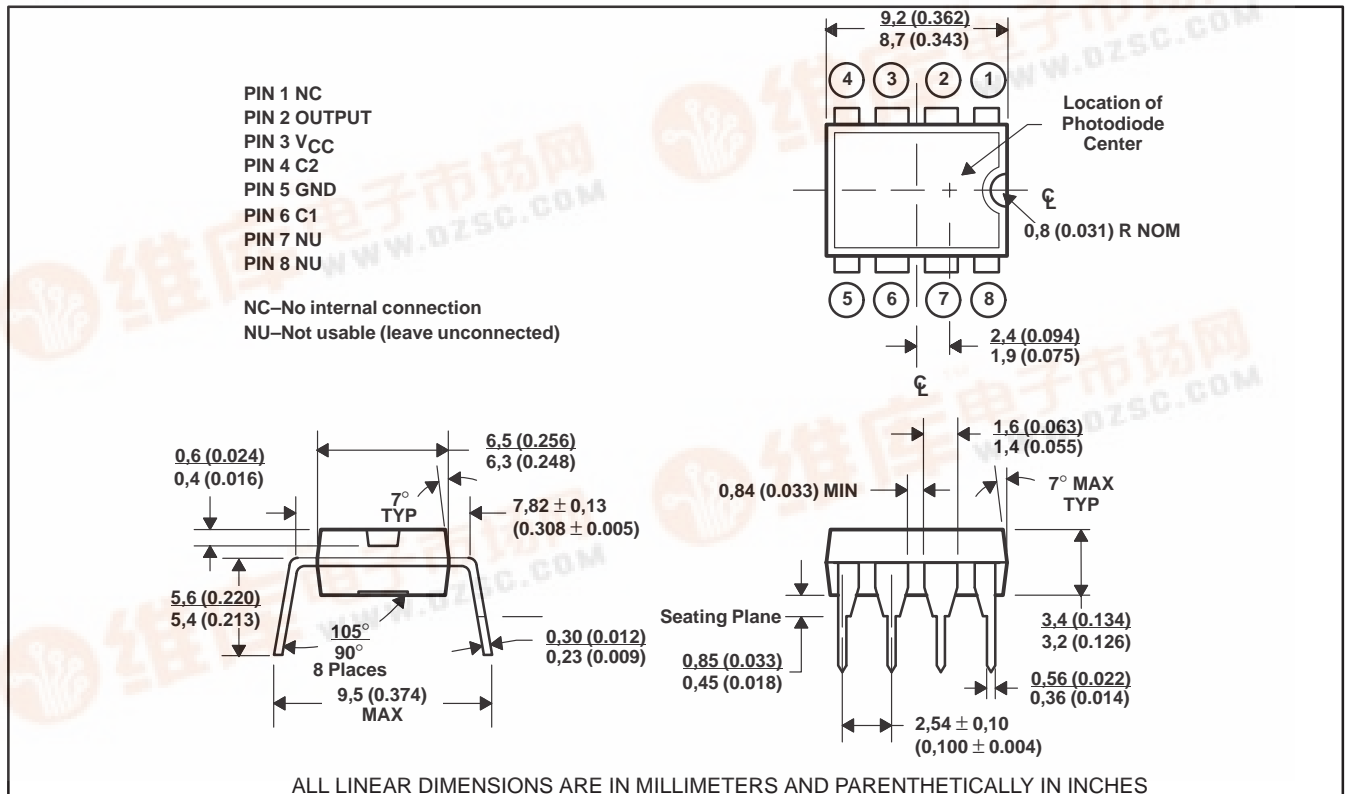
- High-Resolution Conversion of Light Intensity to Frequency
- Wide Dynamic Range . . . 118 dB
- Variable (and Single) Supply Range . . . 5 V to 10 V
- High Linearity . . . Typically Within 2% of FSR (C = 100 pF)
- High Sensitivity . . . Can Detect Change of 0.01% of FSR
- CMOS Compatible Output for Digital Processing
- Minimum External Components
- Microprocessor Compatible

description

The TSL220 consists of a large-area photodiode and a current-to-frequency converter. The output voltage is a pulse train and its frequency is directly proportional to the light intensity (irradiance) on the photodiode. The output is CMOS† compatible and its frequency may be measured using pulse counting, period timing, or integration techniques. The TSL220 is ideal for light-sensing applications requiring wide dynamic range, high sensitivity, and high noise immunity. The output frequency range is determined by an external capacitor; hence, the desired output frequency is adjustable for a given light intensity at the input. The TSL220 is characterized for operation over the temperature range of -25°C to 70°C .

mechanical data

The photodiode and current-to-frequency converter are packaged in a clear plastic 8-pin dual-in-line package. The active chip area is typically $4,13\text{ mm}^2$ (0.0064 in^2).

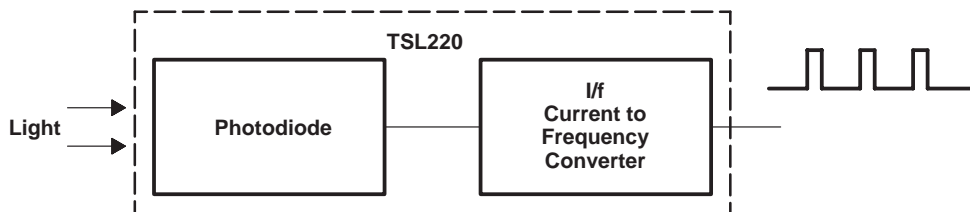


† Use of LSTTL logic families may require a 3300-Ω pulldown resistor on the output.

TSL220 LIGHT-TO-FREQUENCY CONVERTER

SOES003 – AUGUST 1990 – REVISED JUNE 1991

functional block diagram



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)	12 V
Operating free-air temperature, T_A	-25°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

NOTE 1: All voltage values are with respect to GND (pin 5).

recommended operating conditions

	MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}	4	5	10	V
Output frequency, f_o ($C \leq 100$ pF)			750	kHz
Operating free-air temperature range, T_A	-25		70	°C

electrical characteristics at $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$ (see Figure 1)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OM}	Peak output voltage	$R_L = 50$ k Ω	3	4		V
I_{CC}	Supply current	$C = 100$ pF, $E_e = 0$		7.5	10	mA

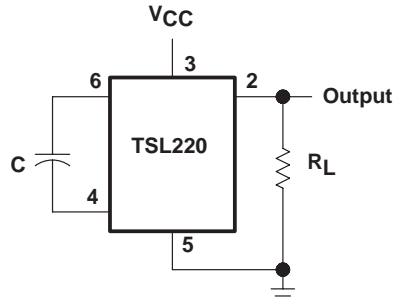
operating characteristics at $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$ (see Figure 1)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_o	Output frequency	$E_e = 125$ $\mu\text{W}/\text{cm}^2$, $\lambda = 880$ nm, $C = 100$ pF	50	150	250	kHz
		$E_e = 0$, $C = 100$ pF	0	1	50	Hz
t_w	Output pulse duration	$C = 470$ pF		1		μs
t_r	Output pulse rise time	$C = 100$ pF		20		ns
t_f	Output pulse fall time	$C = 100$ pF		120		ns

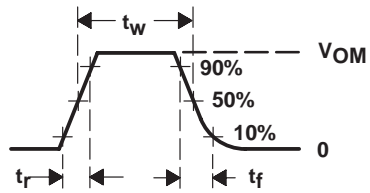
TSL220 LIGHT-TO-FREQUENCY CONVERTER

SOES003 – AUGUST 1990 – REVISED JUNE 1991

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



OUTPUT WAVEFORM

NOTE: Output waveform is monitored on an oscilloscope with the following characteristics: $R_L \geq 1 \text{ M}\Omega$, $C_i \leq 6.5 \text{ pF}$.

Figure 1. Switching Times

TYPICAL CHARACTERISTICS

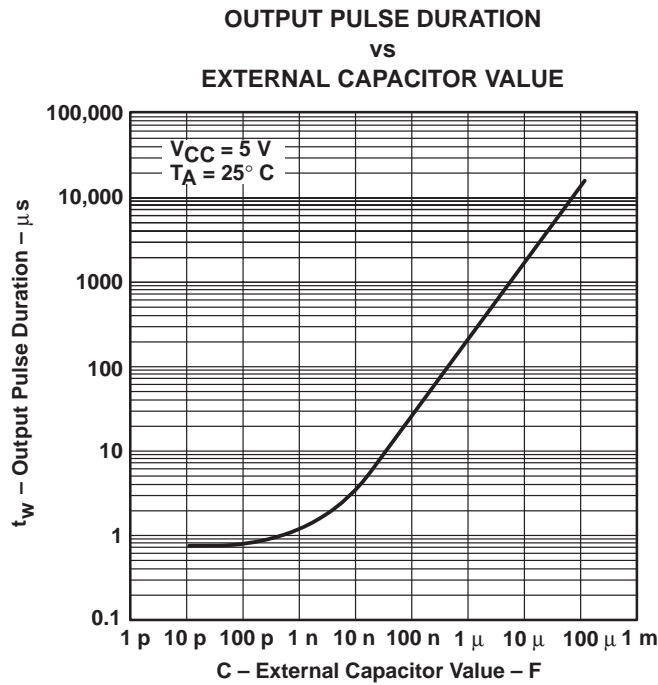


Figure 2

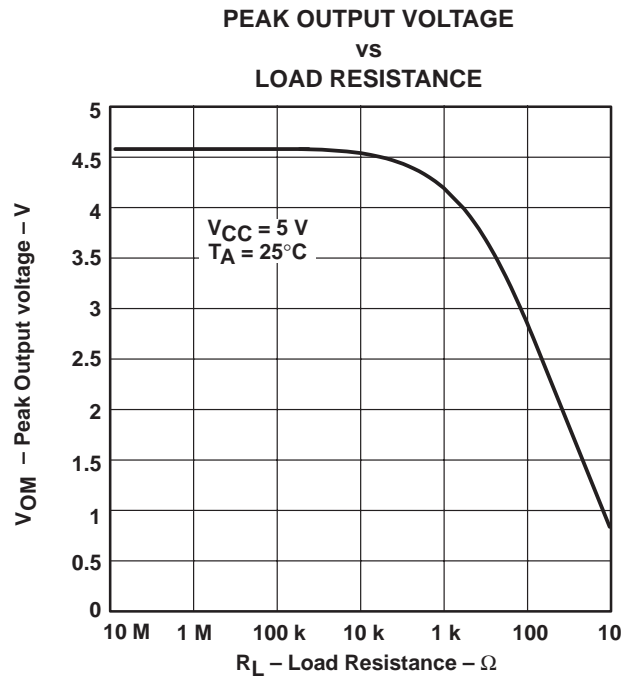


Figure 3

TSL220 LIGHT-TO-FREQUENCY CONVERTER

SOES003 – AUGUST 1990 – REVISED JUNE 1991

TYPICAL CHARACTERISTICS

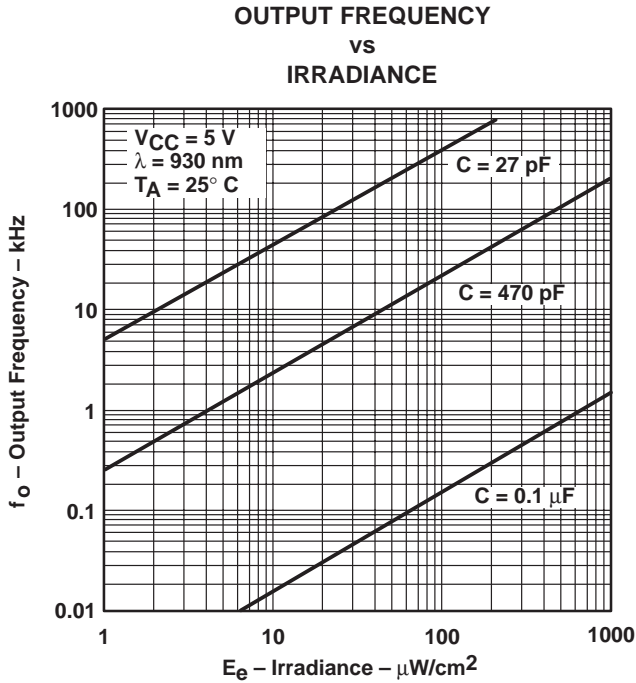


Figure 4

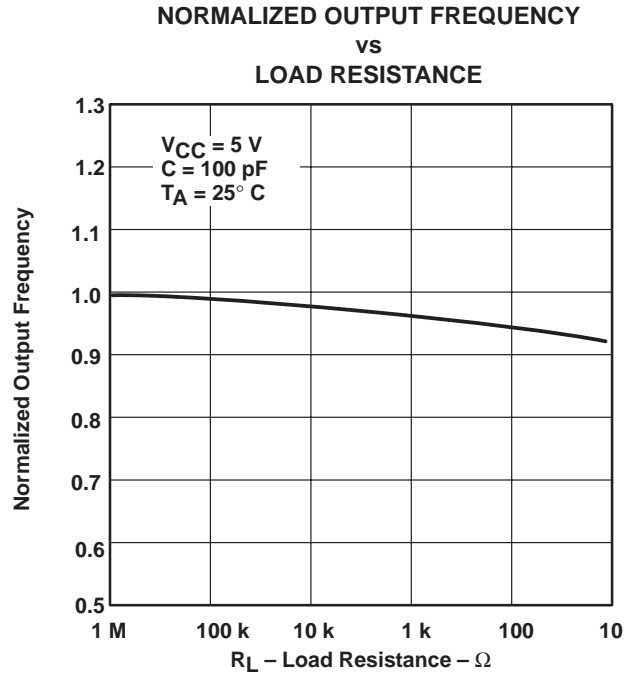


Figure 5

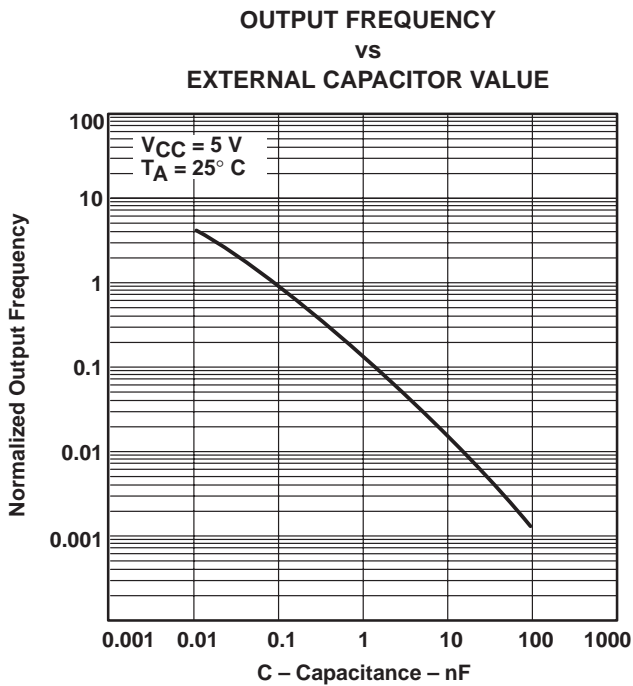


Figure 6

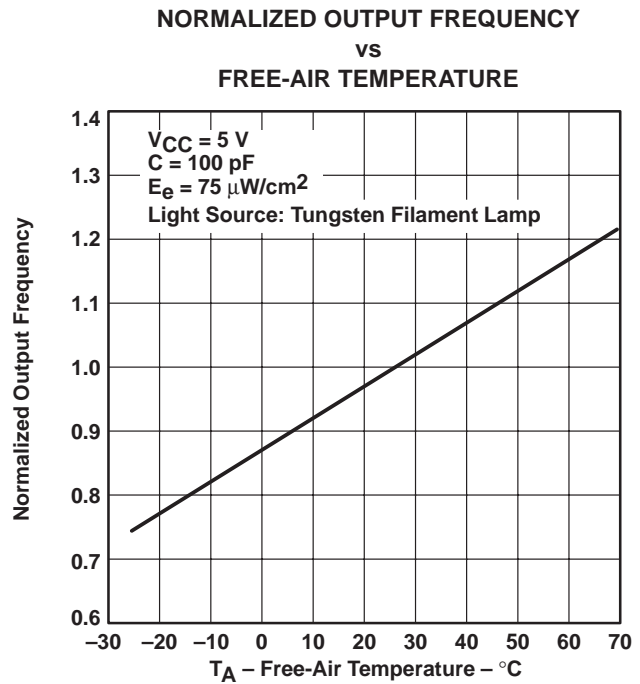


Figure 7

TYPICAL CHARACTERISTICS

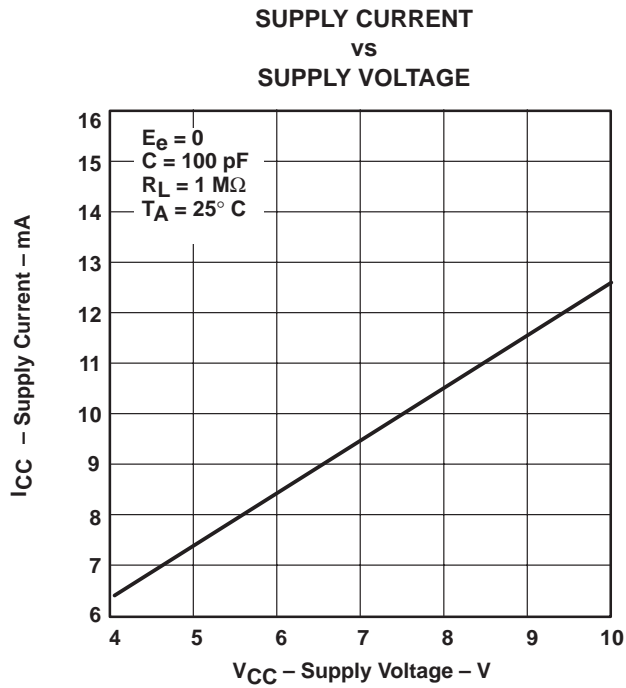


Figure 8

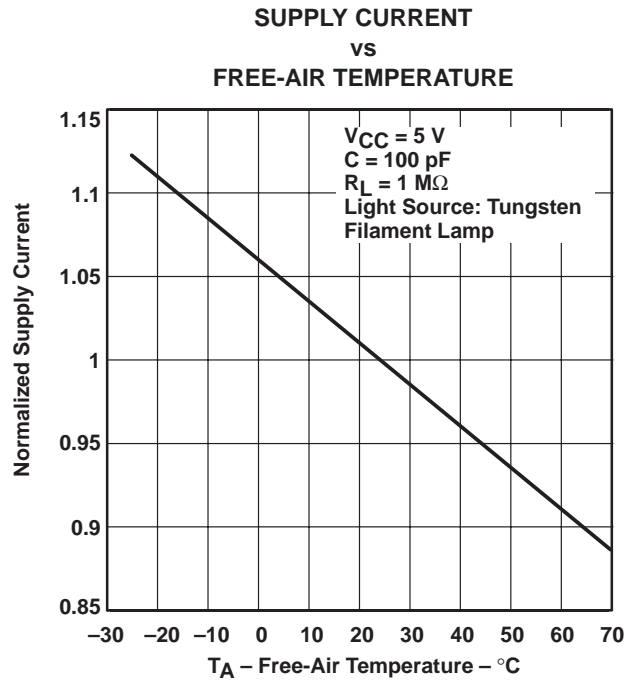


Figure 9

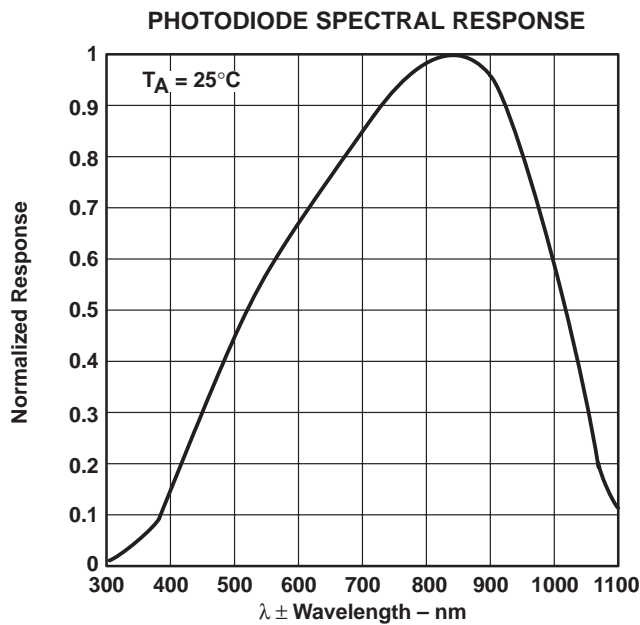


Figure 10

TSL220 LIGHT-TO-FREQUENCY CONVERTER

SOES003 – AUGUST 1990 – REVISED JUNE 1991

APPLICATION INFORMATION

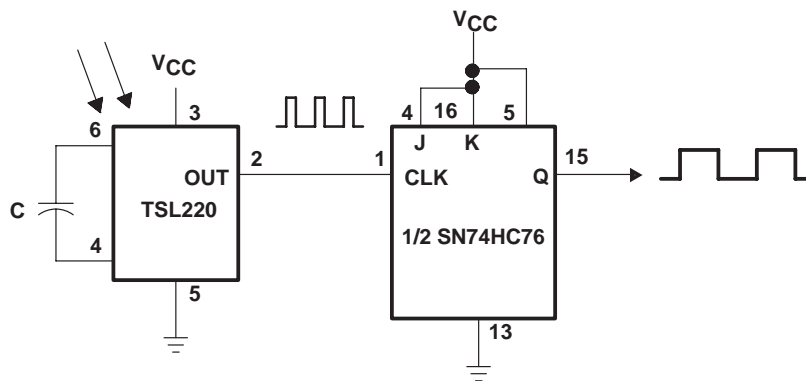
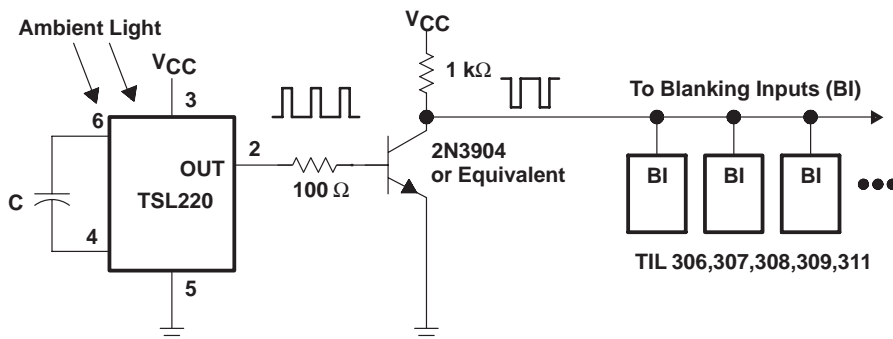


Figure 11. Light-to-Frequency Converter with Square-Wave Output



NOTE: Adjust C to set maximum and minimum brightness levels.

Figure 12. Automatic Display Dimming Circuit

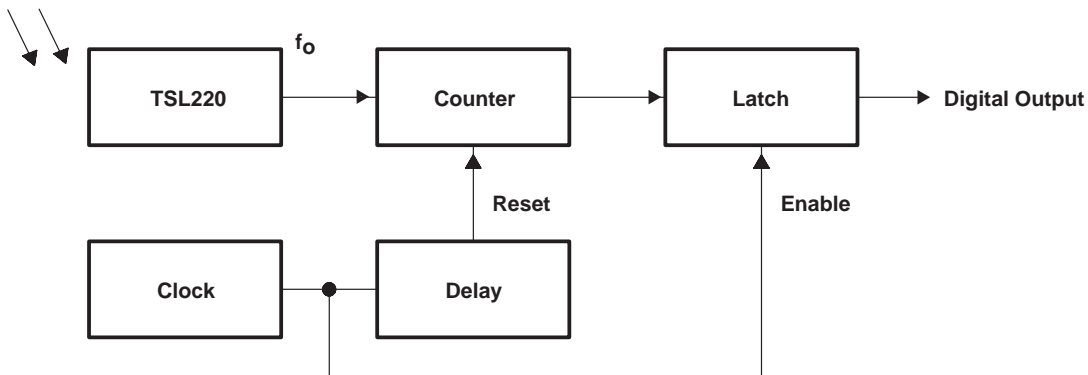


Figure 13. Light-to-Digital Converter

TSL220 LIGHT-TO-FREQUENCY CONVERTER

SOES003 – AUGUST 1990 – REVISED JUNE 1991

APPLICATION INFORMATION

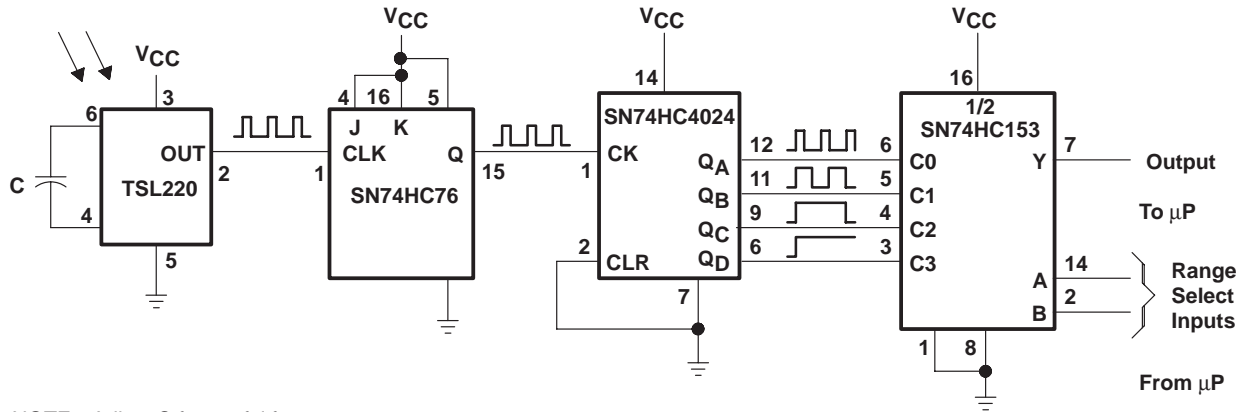


Figure 16. Light Detector with Microprocessor (Microcontroller) and Autoranging Capability

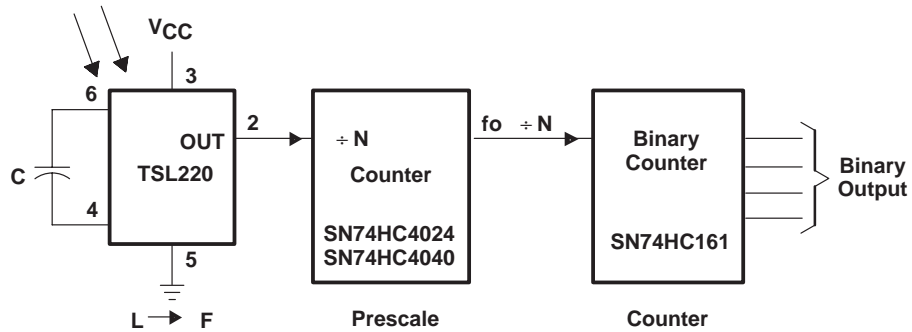


Figure 17. Digital Light Integrator

TSL220 LIGHT-TO-FREQUENCY CONVERTER

SOES003 – AUGUST 1990 – REVISED JUNE 1991

APPLICATION INFORMATION

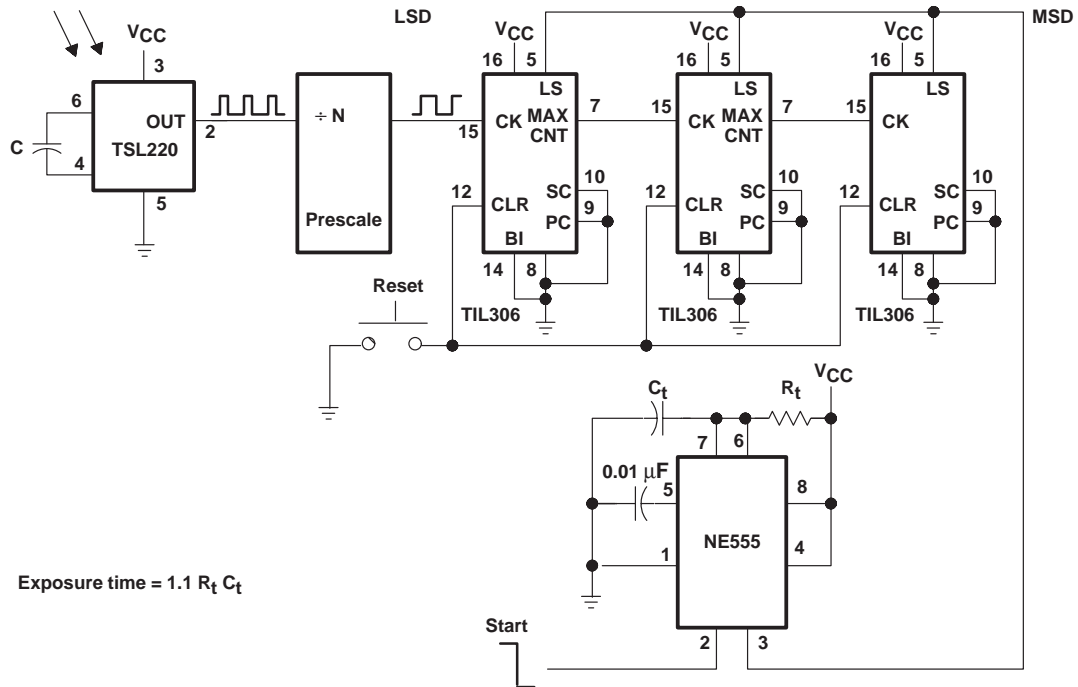


Figure 18. Digital Light Exposure Meter

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.