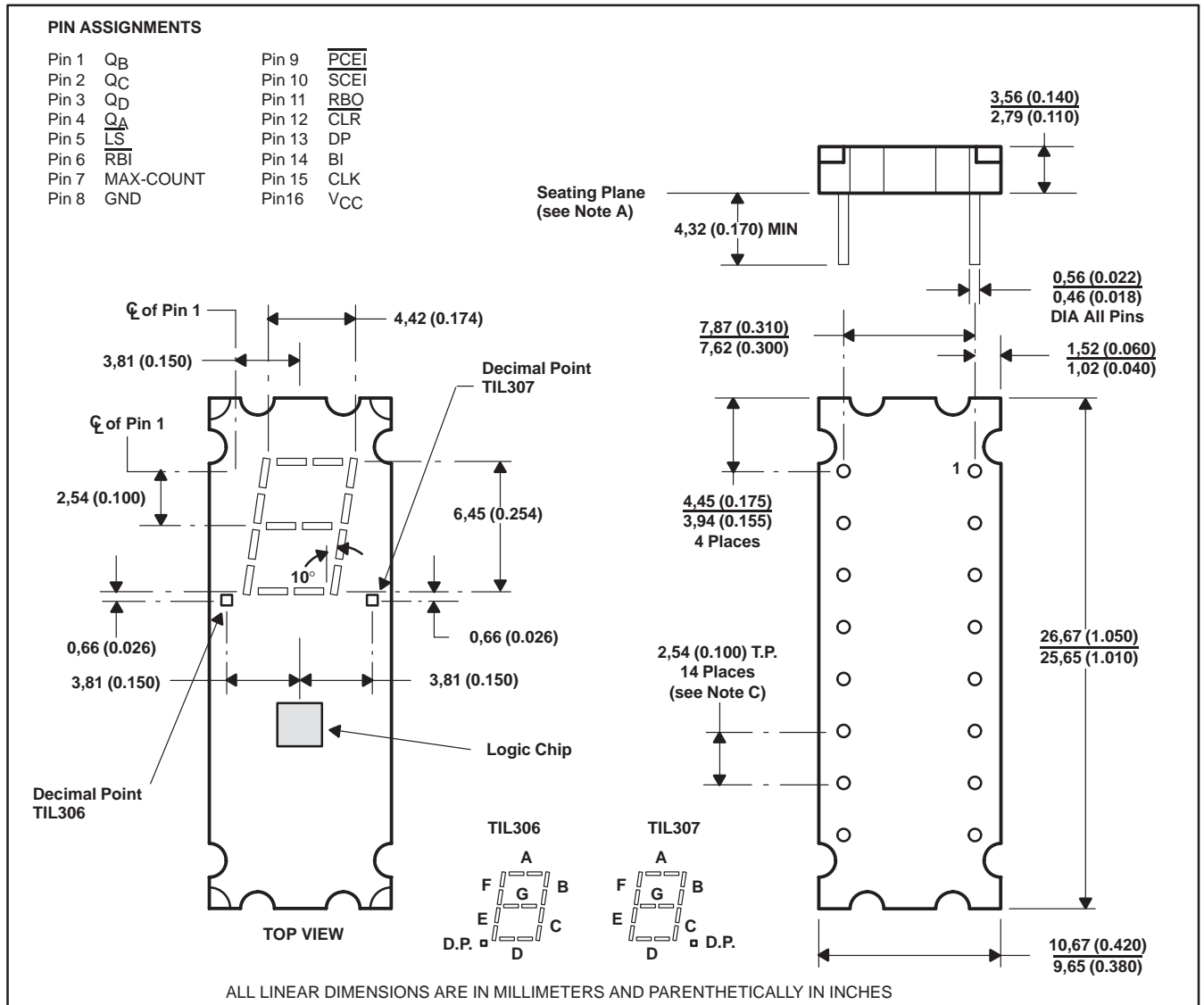


## SOLID-STATE DISPLAYS WITH INTEGRAL TTL MSI CIRCUIT CHIP FOR USE IN ALL SYSTEMS WHERE THE DATA TO BE DISPLAYED IS THE PULSE COUNT

- 6,9-mm (0.270-Inch) Character Height
- High Luminous Intensity
- TIL306 Has Left Decimal
- TIL307 Has Right Decimal
- Easy System Interface
- Wide Viewing Angle
- Internal TTL MSI Chip and Counter, Latch, Decoder, and Driver
- Constant-Current Drive for Light-Emitting Diodes

### mechanical data

These assemblies consist of display chips and a TTL MSI chip mounted on a header with a red molded plastic body. Multiple displays may be mounted on 11,43-mm (0.450-inch) centers.

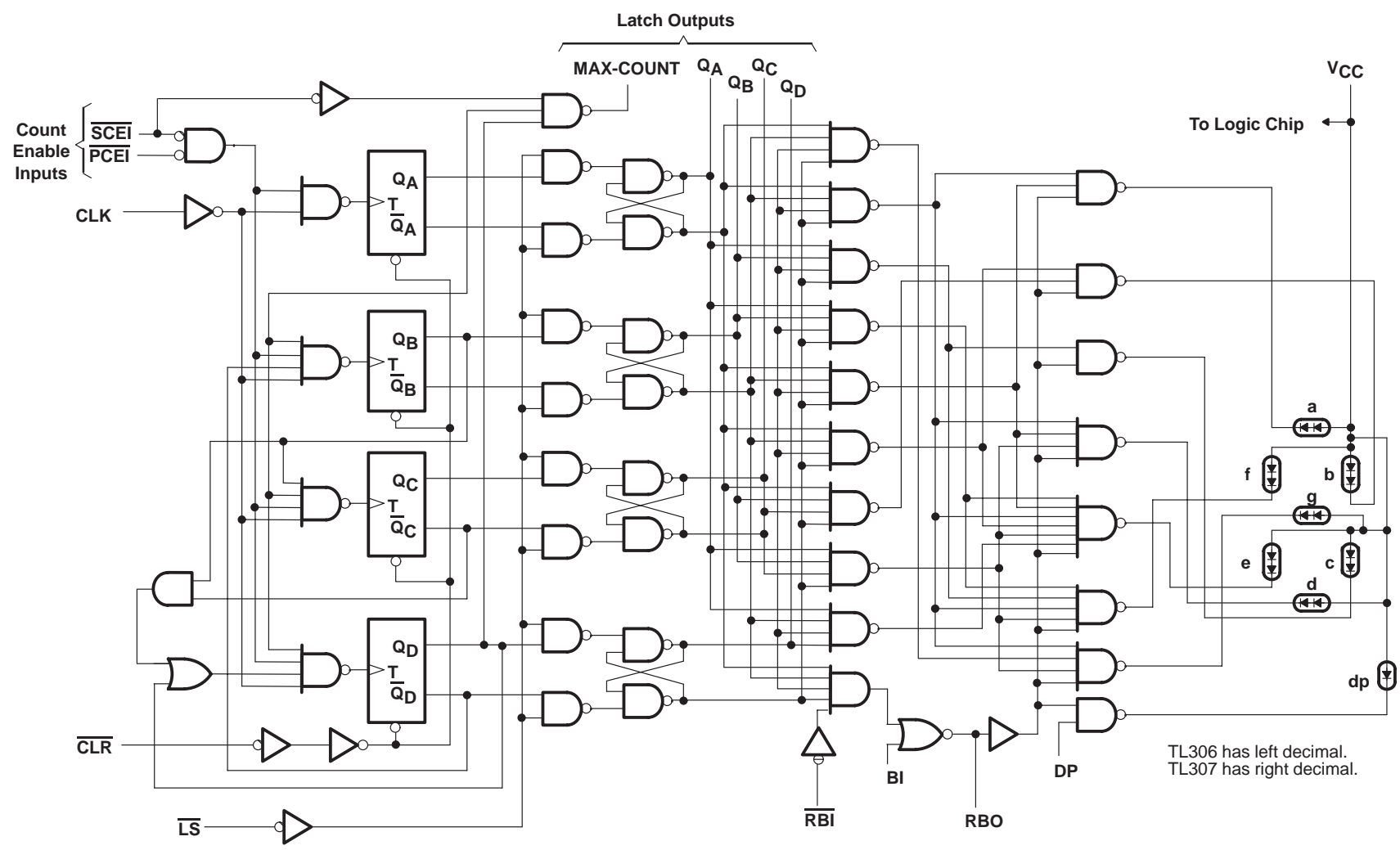


- NOTES: A. Lead dimensions are not controlled above the seating plane.  
 B. Centerlines of character segments and decimal points are shown as dashed lines. Associated dimensions are nominal.  
 C. The true-position pin spacing is 2,54 mm (0.100 inch) between centerlines. Each centerline is located with 0,26 mm (0.010 inch) of its true longitudinal position relative to pins 1 and 16.

# TL306, TL307 NUMERIC DISPLAYS WITH LOGIC

SLS001-D1034, JUNE 1982-REVISED SEPTEMBER 1992

## logic diagram



TL306 has left decimal.  
TL307 has right decimal.

Synchronous BCD counter, 4-bit latch, decoder/driver, seven-segment LED display with decimal point

## description

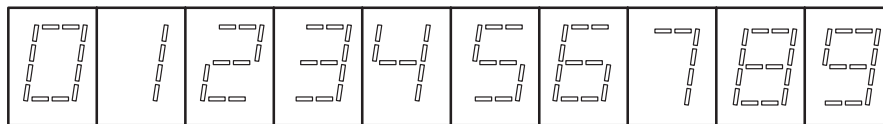
These internally-driven seven-segment light-emitting-diode (LED) displays contain a BCD counter, a four-bit latch, and a decoder/LED driver in a single 16-pin package. A description of the functions of the inputs and outputs of these devices are in the terminal function table.

The TTL MSI circuits contain the equivalent of 86 gates on a single chip. Logic inputs and outputs are completely TTL/DTL compatible. The buffered inputs are implemented with relatively large resistors in series with the bases of the input transistors to lower drive-current requirements to one-half of that required for a standard Series 54/74 TTL input. The serial-carry input, actually two internal loads, is rated as one standard series 54/74 load.

The logic outputs, except RBO, are active pullup, and the latch outputs  $Q_A$ ,  $Q_B$ ,  $Q_C$ , and  $Q_D$  are each capable of driving three standard Series 54/74 loads at a low logic level or six loads at a high logic level while the maximum-count output is capable of driving five Series 54/74 loads at a low logic level or ten loads at a high logic level. The RBO node with passive pull-up serves as a ripple-blanking output with the capability to drive three Series 54/74 loads.

The LED driver outputs are designed specifically to maintain a relatively constant on-level current of approximately 7 mA through each LED segment and decimal point. All inputs are diode clamped to minimize transmission-line effects, thereby simplifying system design. Maximum clock frequency is typically 18 MHz and power dissipation is typically 600 mW with all segments on.

The display format is as follows:



The displays may be interconnected to produce an n-digit display with the following features:

- Ripple-blanking input and output for blanking leading or trailing zeroes
- Floating-decimal-point logic capability
- Overriding blanking for suppressing entire display or pulse modulation of LED brightness
- Dual count-enable inputs for parallel lookahead and serial ripple logic to build high-speed fully synchronous, multidigit counter systems with no external logic, minimizing total propagation delay from the clock to the last latch output
- Provision for ripple-count cascading between packages
- Positive-edge-triggered synchronous BCD counter
- Parallel BCD data outputs available to drive logic processors or remote slaved displays simultaneously with data being displayed
- Latch strobe input allows counter to operate while a previous data point is displayed
- Reset-to-zero capability with clear input.

# TIL306, TIL307 NUMERIC DISPLAYS WITH LOGIC

SLBS001 – D1034, JUNE 1982 – REVISED SEPTEMBER 1992

## Terminal Functions

PIN		DESCRIPTION
NAME	NO.	
BLANKING Input (BI)	14	When high, will blank (turn off) the entire display and force RBO low. Must be low for normal display. May be pulsed to implement intensity control of the display.
CLEAR Input (CLR)	12	When low, resets and holds counter at 0. Must be high for normal counting.
CLOCK Input (CLK)	15	Each positive-going transition will increment the counter provided that the circuit is in the normal counting mode (serial and parallel count enable inputs low, clear input high).
DECIMAL POINT Input (DP)	13	Must be high to display decimal point. The decimal point is not displayed when this input is low or when the display is blanked.
LATCH Outputs (QA, QB, QC, QD)	4, 1, 2, 3	The BCD data that drives the decoder can be stored in the 4-bit latch and is available at these outputs for driving other logic and/or processors. The binary weights of the outputs are: QA = 1, QB = 2, QC = 4, QD = 8.
LATCH STROBE Input (LS)	5	When low, data in latches follow the data in the counter. When high, the data in the latches are held constant, and the counter may be operated independently.
MAX-COUNT Output	7	Will go low when the counter is at 9 and serial count enable input is low. Will return high when the counter changes to 0 and will remain high during counts 1 through 8. Will remain high (inhibited) as long as serial count enable input is high.
PARALLEL Count Enable Input (PCEI)	9	Must be low for normal counting mode. When high, counter will be inhibited. Logic level must not be changed when the clock is low.
RIPPLE-BLANKING Input (RBI)	6	When the data in the latches is BCD 0, a low input will blank the entire display and force the RBO low. This input has no effect if the data in the latches is other than 0.
RIPPLE-BLANKING Output (RBO)	11	Supplies ripple-blanking information for the ripple-blanking input of the next decade. Provides a low if BI is high, or if RBI is low and the data in the latches is BCD 0; otherwise, this output is high. This pin has a resistive pullup circuit suitable for performing a wire-AND function with any open-collector output. Whenever this pin is low, the entire display will be blanked; therefore, this pin may be used as an active-low blanking input.
SERIAL Count Enable Input (SCEI)	10	Must be low for normal counting mode, also must be low to enable maximum count output to go low. When high, counter will be inhibited and maximum count output will be driven high. Logic level must not be changed when the clock is low.

### absolute maximum ratings over operating case temperature range (unless otherwise noted)

Supply voltage, V <sub>CC</sub> (see Note 1): Continuous	5.5 V
Nonrepetitive peak, t <sub>w</sub> ≤ 100 ms	7 V
Input voltage (see Note 1)	5.5 V
Operating case temperature range, T <sub>C</sub> (see Note 2)	0°C to 85°C
Storage temperature range	-25°C to 85°C

- NOTES: 1. Voltage values are with respect to network ground terminal.  
2. Case temperature is the surface temperature of the plastic measured directly over the integrated circuit. Forced-air cooling may be required to maintain this temperature.

**recommended operating conditions**

			MIN	NOM	MAX	UNIT
Supply voltage, $V_{CC}$			4.75	5	5.25	V
Normalized fan-out from each output, N (to Series 54/74 integrated circuits)	Low logic level	$Q_A, Q_B, Q_C, Q_D, RBO$			3	
		MAX-COUNT Output			5	
	High logic level	RBO			3	
		$Q_A, Q_B, Q_C, Q_D$			6	
		MAX-COUNT Output			10	
Clock pulse duration, $t_w(\text{clock})$		High logic level	25			ns
		Low logic level	55			
Clear pulse duration, $t_w(\text{clear})$			25			ns
Latch strobe pulse duration, $t_w(\text{latch strobe})$			45			ns
Setup time, $t_{su}$	PCEI/SCEI↑ before CLOCK↑		30			ns
	CLEAR↑ before CLOCK↑		60			
Operating case temperature, $T_C$			0		70	°C

**electrical characteristics at 25°C case temperature**

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT			
$V_{IH}$	High-level input voltage		2			V			
$V_{IL}$	Low-level input voltage				0.8	V			
$V_{IK}$	Input clamp voltage	$V_{CC} = 4.75\text{ V}, I_I = -12\text{ mA}$			-1.5	V			
$V_{OH}$	High-level output voltage	RBO	$V_{CC} = 4.75\text{ V}, I_{OH} = -120\text{ }\mu\text{A}$	2.4		V			
		$Q_A, Q_B, Q_C, Q_D$	$V_{CC} = 4.75\text{ V}, I_{OH} = -240\text{ }\mu\text{A}$						
		MAX-COUNT Output	$V_{CC} = 4.75\text{ V}, I_{OH} = -400\text{ }\mu\text{A}$						
$V_{OL}$	Low-level output voltage (see Note 3)	$Q_A, Q_B, Q_C, Q_D, RBO$	$V_{CC} = 4.75\text{ V}, I_{OL} = 4.8\text{ mA}$		0.4	V			
		MAX-COUNT Output	$V_{CC} = 4.75\text{ V}, I_{OL} = 8\text{ mA}$						
$I_I$	Input current at maximum input voltage	$V_{CC} = 5.25\text{ V}, V_I = 5.5\text{ V}$			1	mA			
$I_{IH}$	High-level input current	SCEI	$V_{CC} = 5.25\text{ V}, V_I = 2.4\text{ V}$			40			
		RBO node					-0.12	-0.5	mA
		Other inputs							20
$I_{IL}$	Low-level input current	SCEI	$V_{CC} = 5.25\text{ V}, V_I = 0.4\text{ V}$			-1.6			
		RBO node					-1.5	-2.4	mA
		Other inputs							-0.8
$I_{OS}$	Short-circuit output current	$Q_A, Q_B, Q_C, Q_D$	$V_{CC} = 5.25\text{ V}$			-9			
		MAX-COUNT Output					-15	-55	mA
$I_{CC}$	Supply current	$V_{CC} = 5.25\text{ V},$ See Note 4		120	200	mA			
$I_v$	Luminous intensity (see Note 5)	Figure B	$V_{CC} = 5\text{ V}$			700			
		DP Input				40	70	$\mu\text{cd}$	
$\lambda_p$	Wavelength at peak emission	$V_{CC} = 5\text{ V},$ See Note 4		660		nm			
$\Delta\lambda$	Spectral bandwidth	$V_{CC} = 5\text{ V},$ See Note 4		20		nm			

† All typical values are at  $V_{CC} = 5\text{ V}$ .

NOTES: 3. This parameter is measured with the display blanked ( $BI = 5\text{ V}$ ).

4. These parameters are measured with all LED segments and the decimal point on.

5. Luminous intensity is measured with a light sensor and filter combination that approximates the CIE (International Commission on Illumination) eye-response curve.

# TIL306, TIL307 NUMERIC DISPLAYS WITH LOGIC

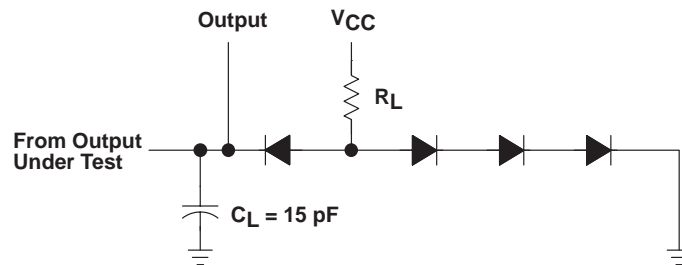
SLBS001 – D1034, JUNE 1982 – REVISED SEPTEMBER 1992

## switching characteristics, $V_{CC} = 5\text{ V}$ , $T_C = 25^\circ\text{C}$

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
$f_{\max}$				12	18		MHz	
$t_{\text{PLH}}$	SERIAL lookahead	MAX-COUNT Output	$C_L = 15\text{ pF}$ , $R_L = 560\ \Omega$ , See Figure 1		12		ns	
$t_{\text{PHL}}$					23			
$t_{\text{PLH}}$	CLK Input	MAX-COUNT Output			26		ns	
$t_{\text{PHL}}$					29			
$t_{\text{PLH}}$	CLK Input	$Q_A, Q_B, Q_C, Q_D$		$C_L = 15\text{ pF}$ , $R_L = 1.2\text{ k}\Omega$ , See Figure 1		28		ns
$t_{\text{PHL}}$						38		
$t_{\text{PHL}}$	CLR Input	$Q_A, Q_B, Q_C, Q_D$			57		ns	

†  $f_{\max}$  ≡ Maximum clock frequency  
 $t_{\text{PLH}}$  ≡ Propagation delay time, low-to-high-level output  
 $t_{\text{PHL}}$  ≡ Propagation delay time, high-to-low-level output

## PARAMETER MEASUREMENT INFORMATION



NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. All diodes are 1N3064.

Figure 1. Load Circuit

TYPICAL CHARACTERISTICS

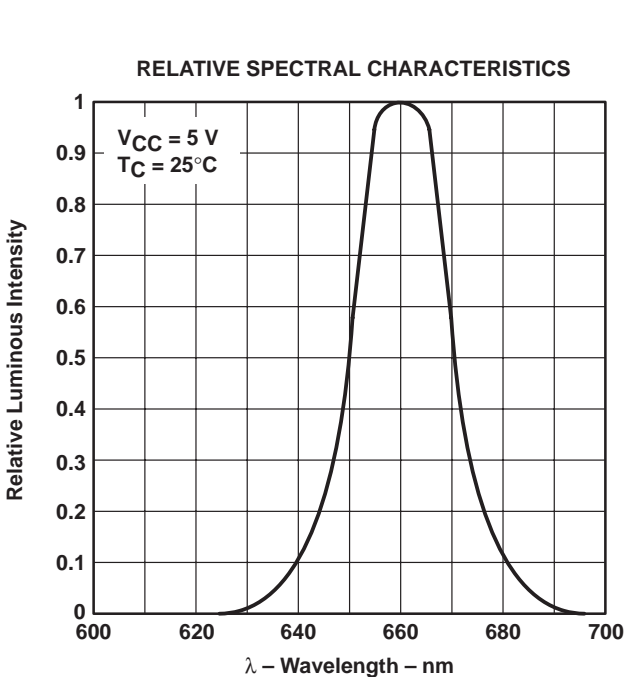


Figure 2

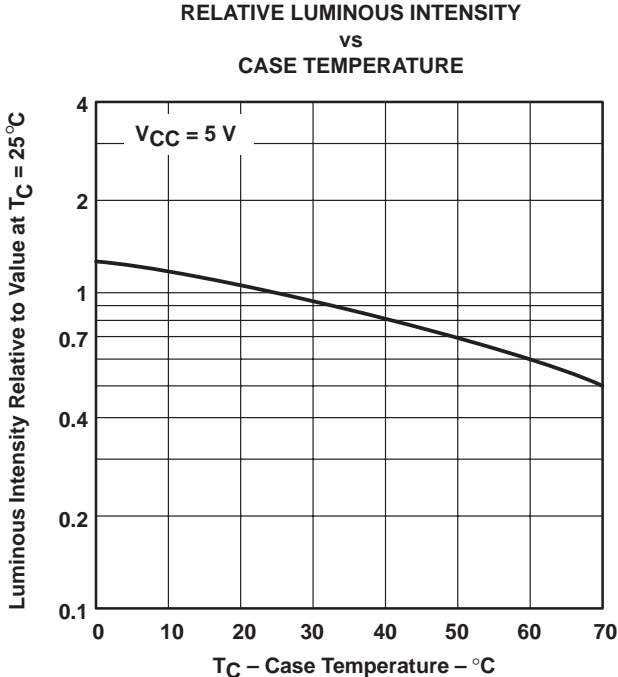


Figure 3

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TIL306	OBSOLETE			16		TBD	Call TI	Call TI
TIL307	OBSOLETE			16		TBD	Call TI	Call TI
TIL307	OBSOLETE			16		TBD	Call TI	Call TI
TIL307	OBSOLETE			16		TBD	Call TI	Call TI

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
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Solid-state displays with integral ttl MSI circuit chip for use. In all systems where the data to be displayed is the pulse count. 6,9-mm (0.270-Inch) Character Height. High Luminous Intensity. TIL306 Has Left Decimal. TIL307 Has Right Decimal. Easy System Interface. Wide Viewing Angle. Internal TTL MSI Chip and Counter, Latch, Decoder, and Driver. Constant-Current Drive for Light-Emitting Diodes. mechanical data. These assemblies consist of display chips and a TTL MSI chip mounted on a header with a red molded plastic body. Multiple displays may be mounted on 11,43-mm (0.450 Solid-state displays with integral ttl MSI circuit chip for use in all systems where the data to be displayed is the pulse count. 6,9-mm (0.270-Inch) Character Height. Wide Viewing Angle. Latch strobe input allows counter to operate while a previous data point is displayed. Reset-to-zero capability with clear input. An integrated circuit or monolithic integrated circuit (also referred to as an IC, a chip, or a microchip) is a set of electronic circuits on one small flat piece (or "chip") of semiconductor material that is normally silicon. The integration of large numbers of tiny MOS transistors into a small chip results in circuits that are orders of magnitude smaller, faster, and less expensive than those constructed of discrete electronic components. The IC's mass production capability, reliability, and (Display Horizontal Sync for TTL interface) 49 O Reserved. Leave unconnected. (Display Vertical Sync for TTL interface). Table 7. TTL Display Interface. No I/O Description For 8-bit panels. For 6-bit panels. used with the crystal as shown in Figure 6. The loading capacitance (Cload) on the crystal is the combination of CL1 and CL2 and is calculated by  $C_{load} = ((CL1 * CL2) / (CL1 + CL2)) + C_{shunt}$ . The shunt capacitance Cshunt is the effective capacitance between the XTAL and TCLK pins. For the gm5221 this is approximately 9 pF.