



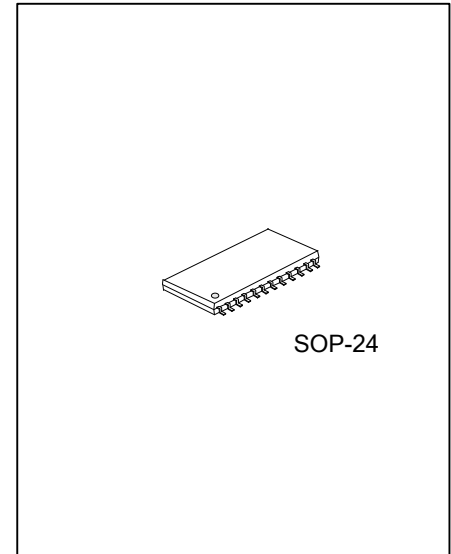
UL316

LINEAR INTEGRATED CIRCUIT

SERIAL-INTERFACED 6-DIGIT LED CONTROLLER IC WITH KEYSKAN

■ DESCRIPTION

The **UL316** is a compact LED controller and driver that interface microprocessors to LED displays through a serial 3-wire interface. It drives LED connected in common anode configuration. The **UL316** drives up to 48 discrete LEDs in 8 segment/6 digit configuration while functioning from a supply voltage of 5.0V.



SOP-24

■ FEATURES

- * LED driver with 14 outputs (8 segments/6 digits)×40 mA load current capability for each segment
- * Output pins connected directly to the LEDs or can be open-drain
- * Key-scanning (8 x 2 matrix)
- * 3-wire serial bus interface (CLK, STB, DIN/DOUT)
- * 8-step dimming circuit to control the overall display brightness

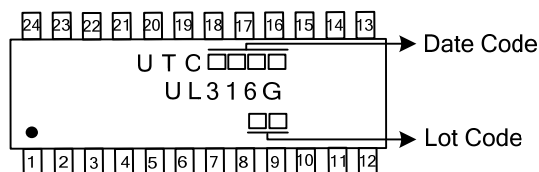
- * Single external resistor for output current setting
- * Inputs with Schmitt trigger give superior noise immunity
- * A single LED digit output (DIG1_LED) can be used to drive up to 8 discrete LEDs
- * 8-step dimming circuit to control brightness of individual LEDs for LED digit
- * 5.0 V (± 10%) for V_{CC}
- * Drives common-anode LED digits
- * Built-in power on reset and soft-start circuits

■ ORDERING INFORMATION

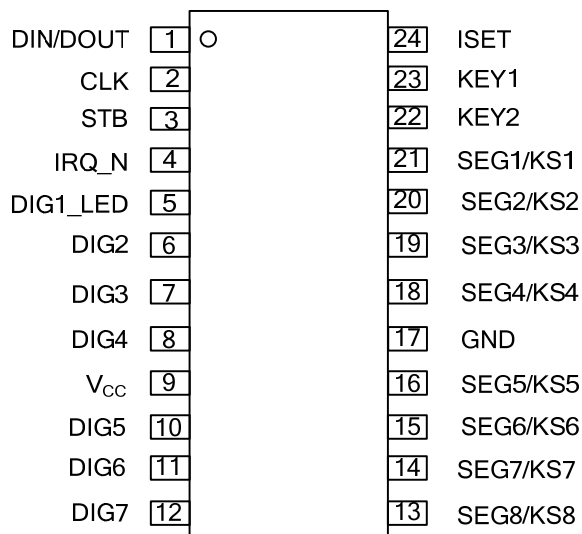
Ordering Number	Package	Packing
UL316G-S24-R	SOP-24	Tape Reel

<p>UL316G-S24-R</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p>	<p>(1) R: Tape Reel (2) S24: SOP-24 (3) G: Halogen Free and Lead Free</p>
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■ MARKING



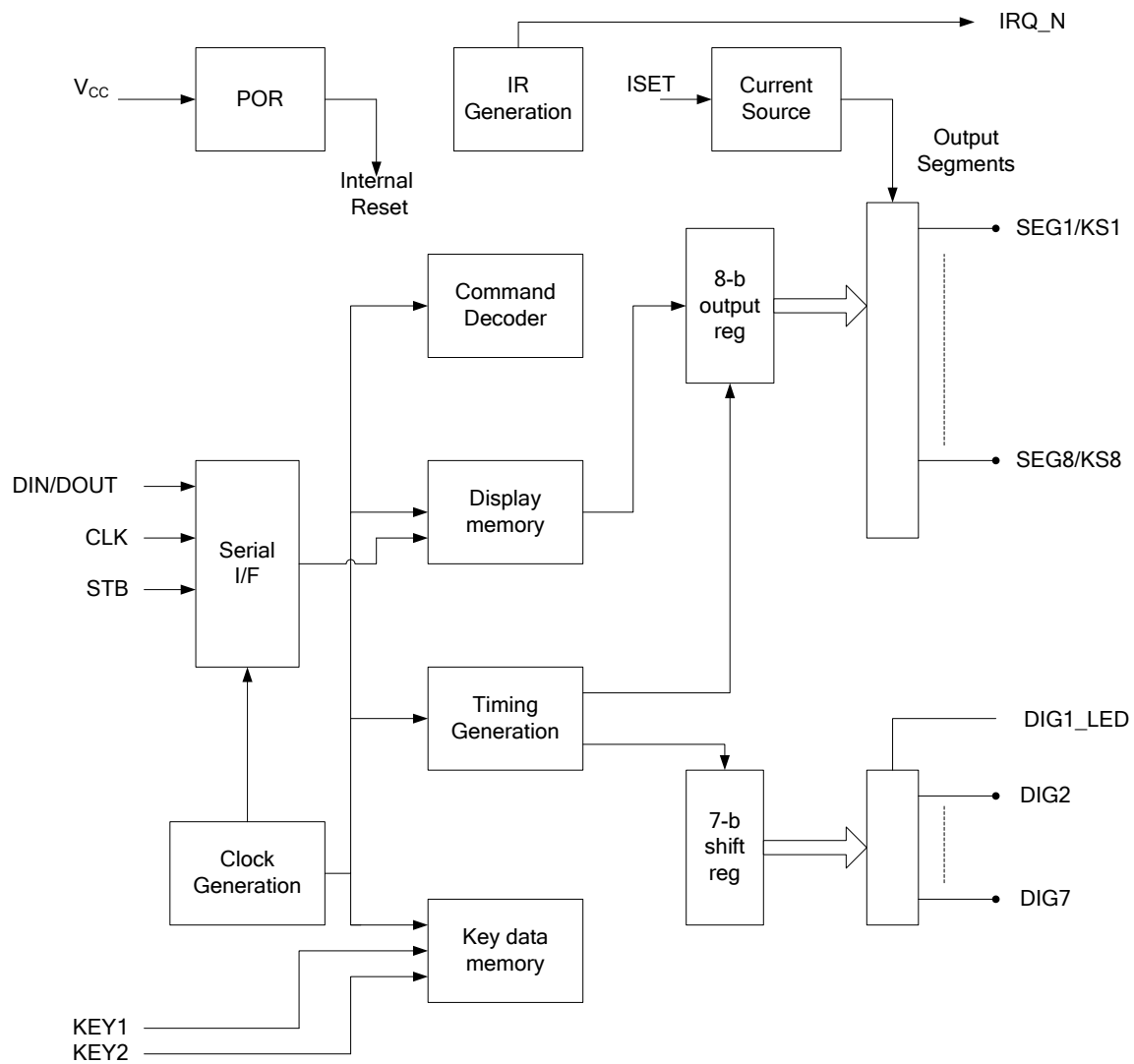
■ PIN CONFIGURATIONS



■ PIN CONFIGURATIONS

PIN NUMBER	SYMBOL	TYPE	NAME AND FUNCTION
1	DIN/DOUT	IN/OUT	Output serial data at falling edge of the shift clock, starting from lower bit. Input serial data is clocked in at rising edge of the shift clock, starting from lower bit.
2	CLK	IN	Reads serial data at rising edge, and outputs data at falling edge.
3	STB	IN	Initializes serial interface at rising or falling edge for reception of command. Data input after the falling edge of STB are processed as a command. While command data are processed, current processing is stopped, and the serial interface is initialized. While STB is high, instructions are ignored.
4	IRQ_N	OUT	Interrupt output (active low) to interrupt the MCU when there is a key press
5	DIG1_LED	OUT	Single output LED used together with the 8 segments to drive up to 8 discrete LEDs
6	DIG2	OUT	Digit output pin
7	DIG3	OUT	Digit output pin
8	DIG4	OUT	Digit output pin
9	V _{CC}	PWR	5.0 V ± 10% Core main supply voltage. Bypass to GND through a 0.1 μF capacitor as close to the pin as possible
10	DIG5	OUT	Digit output pin
11	DIG6	OUT	Digit output pin
12	DIG7	OUT	Digit output pin
13	SEG8/KS8	OUT	Segment output pin (dual function as key source)
14	SEG7/KS7	OUT	Segment output pin (dual function as key source)
15	SEG6/KS6	OUT	Segment output pin (dual function as key source)
16	SEG5/KS5	OUT	Segment output pin (dual function as key source)
17	GND	PWR	Connect this pin to system GND
18	SEG4/KS4	OUT	Segment output pin (dual function as key source)
19	SEG3/KS3	OUT	Segment output pin (dual function as key source)
20	SEG2/KS2	OUT	Segment output pin (dual function as key source)
21	SEG1/KS1	OUT	Segment output pin (dual function as key source)
22	KEY2	IN	Key 2 input
23	KEY1	IN	Key 1 input
24	ISSET	IN	Segment current setting. Connect to GND through a resistor to set the peak segment current.

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS (all voltages are referenced to GND)

PARAMETER	SYMBOL	VALUES	UNIT
Supply Voltage to Ground	V_{CC}	-0.5 to +7	V
Logic Input Voltage	V_{IN}	-0.5 to $V_{CC}+0.5$ V	V
Power Dissipation	P_D	1200	mW
Operating Ambient Temperature	T_A	-40 ~ 85	°C
Junction Temperature	T_J	150	°C
Storage Temperature	T_{STG}	-65 to +150	°C

Note: De-rate at -9.6 mW/°C at $T_A = 25^\circ\text{C}$ or higher.

■ THERMAL DATA

PARAMETER	SYMBOL	VALUES	UNIT
Junction to Case	θ_{JC}	75	°C/W

■ DC ELECTRICAL CHARACTERISTICS

DC electrical characteristics ($T_A = -40$ to $+85^\circ\text{C}$, $V_{CC} = 5.0\text{ V} \pm 10\%$, GND = 0 V)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Logic Supply Voltage	V_{CC}		4.5	5.0	5.5	V
High Level Input Voltage	V_{IH}	High Level Guaranteed Digital Pins	$0.57 \times V_{CC}$		V_{CC}	V
Low Level Input Voltage	V_{IL}	Low Level Guaranteed Digital Pins	0		$0.3 \times V_{CC}$	V
Input Current	I_{IH}, I_{IL}	$V_{IN} = V_{CC}$ or GND	-2		2	μA
Hysteresis Voltage (DIN, CLK, STB pins)	V_{HYS}			1.05		V
Low Level Output Voltage	$V_{OL(DOUT)}$	$D_{OUT}, I_{OL2}=4\text{mA}$			0.4	V
Segment Drive LED Sink Current	I_{SEG}	$V_{LED}=2.5\text{V}, V_{DIGIT}=V_{CC}-1.0$	-30	-40	-50	mA
Digit Drive LED Source Current	I_{DIG}	$V_{DIGIT}=V_{CC}-1.0$	240	320	400	mA
Segment Drive Current Matching	I_{TOLSEG}	$V_{CC}=5.0\text{V}, T_A=25^\circ\text{C}, V_{LED}=2.5\text{ V}$		3		%
External Current Setting Reference Resistor (Precision = $\pm 1\%$ Tolerance)	R_{SET}	$I_{SEG}=40\text{mA}$		360		Ω

■ POWER SUPPLY CHARACTERISTICS ($T_A = -40$ to $+85^\circ\text{C}$, unless otherwise specified)

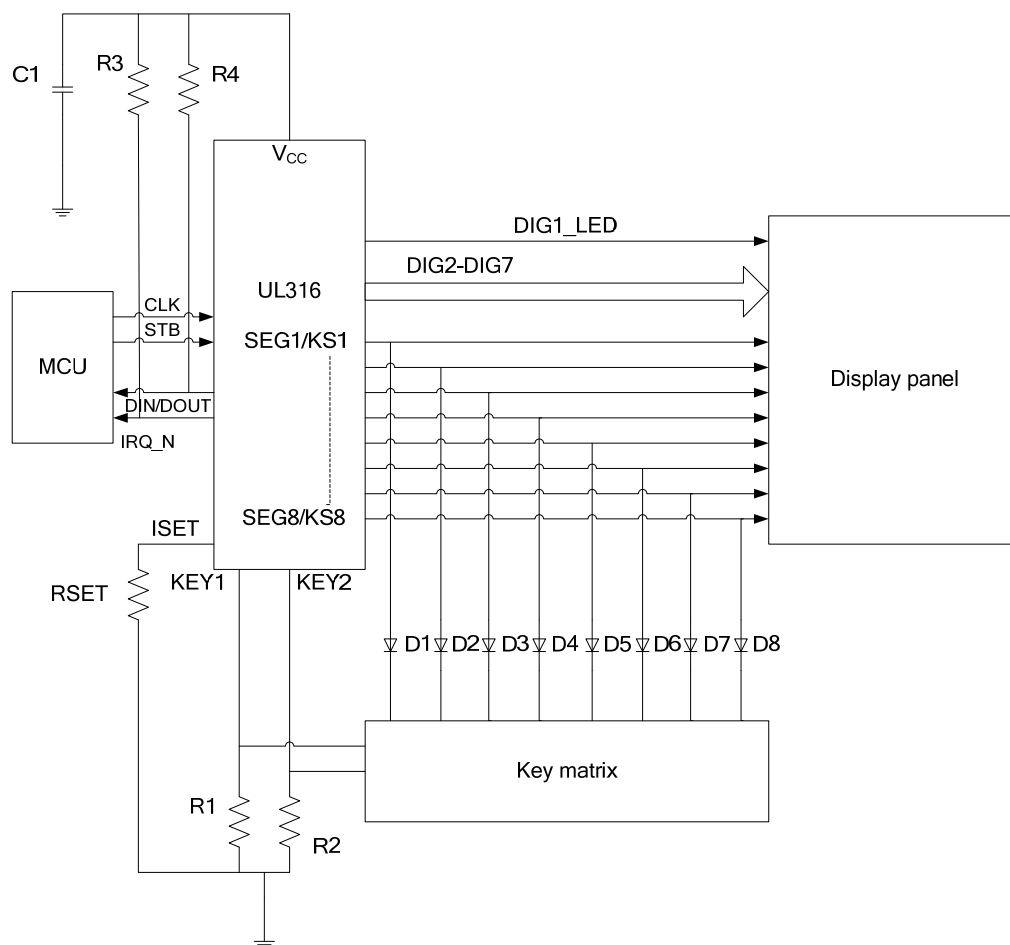
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Quiescent Power Supply Current	I_{STBY}	$V_{CC}=5.5\text{V}$, All Inputs= V_{CC} or GND		50		μA
Operating Power Supply Current (display ON)	I_{CC}	All Segments ON, All Digits Scanned, Intensity Set to Full, Internal Oscillator, No Display Load Connected		10		mA

■ TIMING CHARACTERISTICS

($T_A = -40 \sim +85^\circ\text{C}$, $V_{CC}=5.0\text{V} \pm 10\%$, Typical values are at 25°C , unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Clock Pulse Width	PW_{CLK}		400			ns
Strobe Pulse Width	PW_{STB}		1			μs
Data Setup Time	t_{SETUP}		100			ns
Data Hold Time	t_{HOLD}	CLK Rising Edge to STB Rising Edge	100			ns
Clock-Strobe Time	$t_{CLK-STB}$		1			μs

■ TYPICAL APPLICATION CIRCUIT



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