National Semiconductor

TV Circuits

LM1017 4-Bit Binary 7-Segment Decoder/Driver

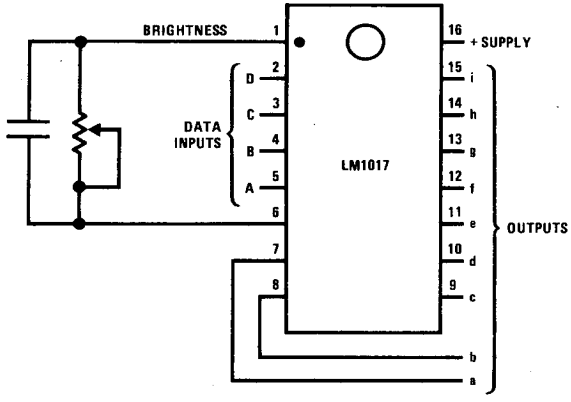
General Description

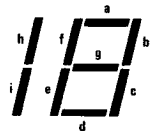
The LM1017 is a monolithic IC which decodes 4-bit "binary plus one" coded input signals and supplies 1 1/2-digit TV channel display information. The outputs are designed to drive a 7-segment common cathode LED display with up to 25 mA depending on thermal dissipation requirements. Improvements in circuit design enable the device to operate from 5V to 12V supply. A brightness control facility is included.

Features

- A direct replacement for SN29764 but with 12V supply capability
- TTL compatible inputs with high input voltage immunity
- Channel displays are from 1 to 16
- Current-driven output stages for LEDs protect against excess thermal dissipation
- Continuously variable brightness control
- Low stand-by quiescent current supply consumption
- Suitable for NSN583 0.5 inch LED display
- Inputs are suitable for direct drive from MOS outputs

Connection Diagram





Order Number LM1017N
See NS Package N16A

V_{SUPPLY} = 5V
For 12V supply, external resistors must be used between the output pin and segment to limit device dissipation.

Absolute Maximum Ratings

Supply Voltage, Pin 16	13.5V	Storage Temperature Range	−55°C to +150°C
Input Voltage, Pins 2–5	30V	Junction Temperature	150°C
Input Voltage, Pin 1	13.5V	Lead Temperature (Soldering, 10 seconds)	300°C
Operating Temperature Range	0°C to +70°C		

Electrical Characteristics $V16 = 5V, T_A = 25°C$

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Current per Segment Quiescent Current, Pin 16	Pin 1 = 2V		12	20	mA
	Pin 1 = 5V		4		mA
Input Logic Voltage	Pins 2–5				
H Signal		2			V
L Signal				0.8	V
Input Current, Pins 2–5	V2–5 = 2.4V			1	μA
	V2–5 = 0V			−5	μA
Input Current, Pin 1	$I_{7-15} = -15$ mA		−350		μA
Output Current, Pins 7–15	V1 = 0V	−16	−22		mA
	V1 = 2V		−12		mA
	V1 = V16			−20	μA
Minimum Saturation Between Output Terminals 7–15 and 16	$I_{OUT} = -20$ mA		1.4		V
Package Thermal Resistance, θ_{JA}				100	°C/W

Note. To limit device temperature at supply voltages > 5V, the following condition must be maintained: $8 (V_{SUPPLY} - V_{OUT}) I_{OUT} < \frac{150 - T_A}{\theta_{JA}}$.

Eg. For 12V supply and 20 mA I_{OUT} into 2V LED, $T_A = 25°C$: $8 (12 - V_O) 0.02 < \frac{125}{100}$

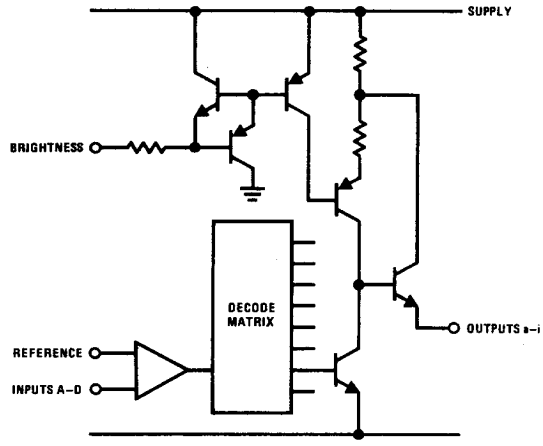
i.e., $V_O > 4.2V$ ∴ series output resistance = $\frac{2.2V}{20\text{ mA}} = 110\Omega$.

See application notes for use of common series resistance between LED cathodes and ground.

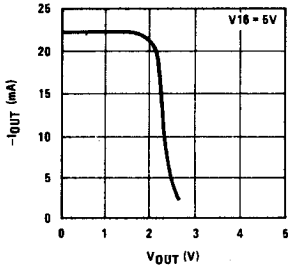
Truth Table

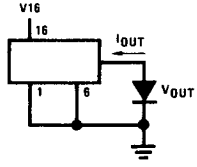
CHANNEL	INPUT					OUTPUT								
	D	C	B	A	BR	a	b	c	d	e	f	g	h	i
1	L	L	L	L	L		ON	ON						
2	L	L	L	H	L	ON	ON		ON	ON		ON		
3	L	L	H	L	L	ON	ON	ON	ON			ON		
4	L	L	H	H	L		ON	ON			ON	ON		
5	L	H	L	L	L	ON		ON	ON		ON	ON		
6	L	H	L	H	L	ON		ON	ON	ON	ON	ON		
7	L	H	H	L	L	ON	ON	ON						
8	L	H	H	H	L	ON	ON	ON	ON	ON	ON	ON		
9	H	L	L	L	L	ON	ON	ON	ON		ON	ON		
10	H	L	L	H	L	ON	ON	ON	ON	ON	ON		ON	ON
11	H	L	H	L	L		ON	ON					ON	ON
12	H	L	H	H	L	ON	ON		ON	ON		ON	ON	ON
13	H	H	L	L	L	ON	ON	ON	ON			ON	ON	ON
14	H	H	L	H	L		ON	ON			ON	ON	ON	ON
15	H	H	H	L	L	ON		ON	ON		ON	ON	ON	ON
16	H	H	H	H	L	ON		ON	ON	ON	ON	ON	ON	ON
OFF	X	X	X	X	H									

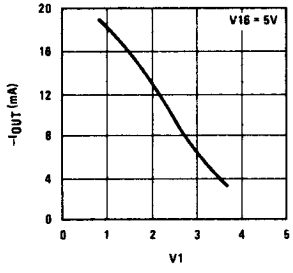
Circuit Schematic (One Circuit Shown)

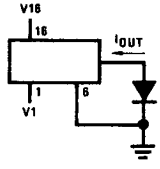


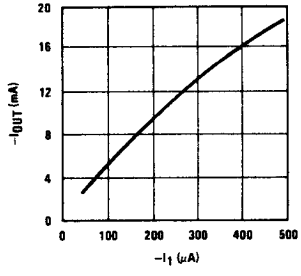
Output Characteristics

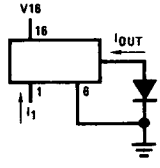








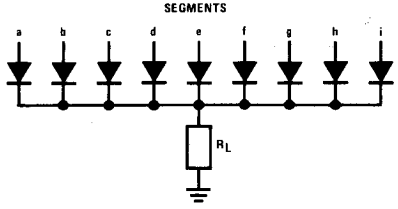




Typical Applications

When operating with a 12V supply line, it is necessary to limit the power dissipation in the IC by means of external resistance in series with the LED segments. (Max package dissipation at 70°C = 800 mW.)

A minimum voltage of 2.5V should be allowed across the output driver pins between supply and outputs. Allowing 1.4V for the LED segments, a simple economical solution using *only 1 resistor* can be proposed as follows:



Maximum no of ON segments = 8

For 20 mA/segment, maximum voltage allowed across R_L will be:

$12 - 2.5 - 1.4 \cong 8V$
$\therefore R_L \text{ max} = 8/8 \times 0.02 \triangleq 47\Omega$

For 15 mA/segment (max), R_L max = 56Ω.

Alternative methods of limiting P_D at 12V supply.

With a series resistance between each output and segment, the recommended resistance per segment at 20 mA maximum will be:

$$(12 - 2.5 - 1.4)/0.02 \triangleq 390\Omega$$

If a zener is used, maximum zener voltage = 8V. (The zener can be common between LED display cathode and ground.)