

# LED level meter driver, 12–point, power scale, dot or bar display

## BA681A

The BA681A is a monolithic IC for LED power meter applications. The display level range is  $6\text{mV}_{\text{rms}}$  to  $359\text{mV}_{\text{rms}}$  (Typ.) divided into 12 points with repeated interval spacings of 3dB, 3dB and 4dB. The 0dB level is  $180\text{mV}_{\text{rms}}$  (Typ.) and the range is  $-30\text{dB}$  to  $+16\text{dB}$ . The constant current outputs can be set using external components allowing use of different color LEDs in various combinations.

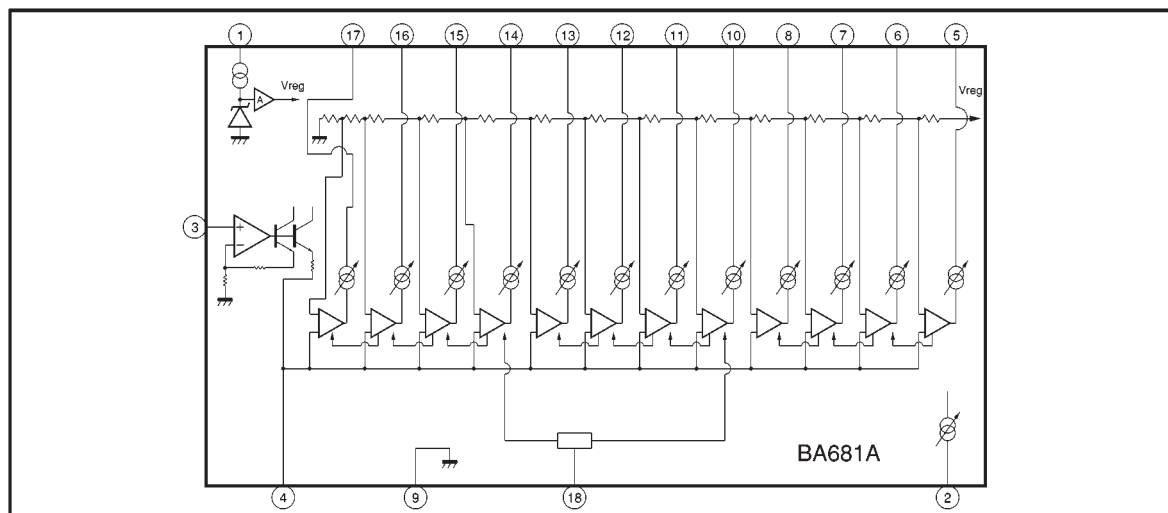
### ● Applications

Level meters for radio cassettes, car stereos, and home stereos

### ● Features

- 1) 12-point power meter driver for bar/dot displays.
- 2) Fixed-current outputs that can directly drive LEDs.
- 3) Output current can be set using external resistors allowing different types of LEDs to be used in combination.
- 4) Built-in half-wave rectifier amplifier.
- 5) LED on and off timing can be set using an external capacitor and resistor.
- 6) With bar-type display, by connecting four LEDs in series, power dissipation is reduced.
- 7) Each group of three LEDs is a 10dB step which is ideal for power meter applications.

### ● Block diagram



● Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V <sub>CC</sub>	15	V
Power dissipation	P <sub>d</sub>	1100*	mW
Operating temperature	T <sub>opr</sub>	-25~+75	°C
Storage temperature	T <sub>stg</sub>	-55~+125	°C

\* Reduced by 11.0mW for each increase in Ta of 1°C over 25°C.

● Electrical characteristics (unless otherwise noted, Ta = 25°C, V<sub>CC</sub> = 12V, and f = 1kHz)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Power supply voltage	V <sub>CC</sub>	10	12	14	V	When V <sub>F(LED)</sub> = 2V
Quiescent current	I <sub>Q</sub>	—	5	10	mA	V <sub>IN</sub> =0V
LED current setting range	I <sub>LED</sub>	—	—	20	mA	Set using R <sub>I</sub> (see Fig. 3)
Pin 5 LED current	I <sub>LED</sub>	12	15	18	mA	R <sub>I</sub> =27kΩ
LED current deviation	Δ I <sub>LED</sub>	-1.5	0	1.5	mA	R <sub>I</sub> =27kΩ With respect to the pin 5 I <sub>LED</sub> value.
Sensitivity	V <sub>IN</sub>	0.12	0.18	0.24	V <sub>rms</sub>	On level for comparator 10.
Comparator level 1	V <sub>C1</sub>	-31.5	-30	-28.5	dB	Pin 17 output
Comparator level 2	V <sub>C2</sub>	—	-27	—	dB	Pin 16 output (use V <sub>R1</sub> to adjust the offset)
Comparator level 3	V <sub>C3</sub>	-25.0	-24	-23.0	dB	Pin 15 output
Comparator level 4	V <sub>C4</sub>	-21.5	-20	-18.5	dB	Pin 14 output
Comparator level 5	V <sub>C5</sub>	-18.5	-17	-15.5	dB	Pin 13 output
Comparator level 6	V <sub>C6</sub>	-15.5	-14	-12.5	dB	Pin 12 output
Comparator level 7	V <sub>C7</sub>	-11.0	-10	-9.0	dB	Pin 11 output
Comparator level 8	V <sub>C8</sub>	-8.0	-7	-6.0	dB	Pin 10 output
Comparator level 9	V <sub>C9</sub>	-5.0	-4	-3.0	dB	Pin 8 output
Comparator level 10	V <sub>C10</sub>	—	0	—	dB	Pin 7 output (V <sub>C10</sub> level is 0dB)
Comparator level 11	V <sub>C11</sub>	2.0	3	4.0	dB	Pin 6 output
Comparator level 12	V <sub>C12</sub>	4.5	6	7.5	dB	Pin 5 output

● Comparator level vs. AC and DC input levels

Comparator level V <sub>c</sub>	1	2	3	4	5	6	7	8	9	10	11	12
dB display (dB)	-30	-27	-24	-20	-17	-14	-10	-7	-4	0	+3	+6
AC input level (mV <sub>rms</sub> )	5.7	8.0	11.4	18	25	36	57	80	114	180	254	359
DC input level (mV)	7.3	10.3	14.5	23	32	46	72	103	145	230	325	459

\* These values are not guaranteed. Use for reference only.

● Measurement circuit

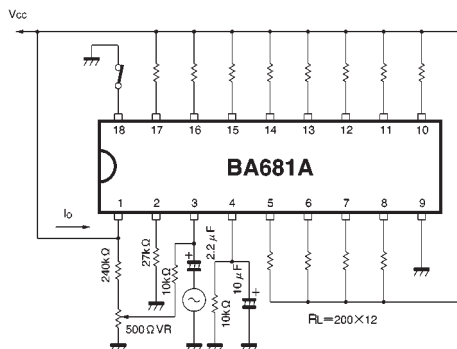
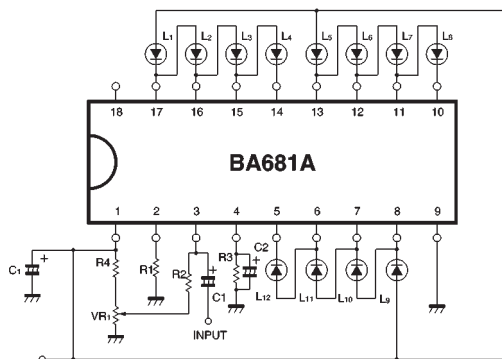
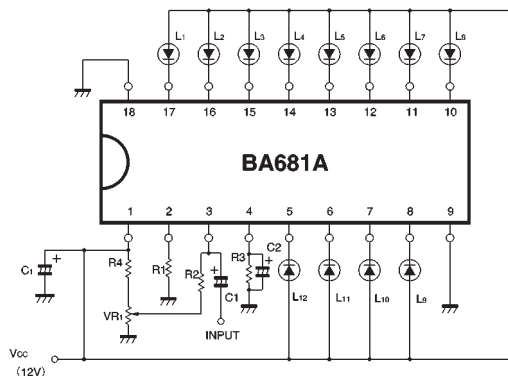


Fig. 1

● Application example



(1) Bar display connections



(2) Dot display connections

Note: Ensure that the voltage on the LED current output pins (5 to 8 and 10 to 17) is always 2V or more. If the voltage is below 2V, the current may drop significantly. Take particular care when using high  $V_f$  LEDs in bar display applications.

Recommended values  
 $R_1 = 27k\Omega$  (green LED) or  $39$  to  $47k\Omega$  (red LED)  
 $R_2 = 10k\Omega$   $C_1 = 2.2\mu F$   
 $R_3 = 10k\Omega$   $C_2 = 10\mu F$   
 $R_4 = 240k\Omega$   $C_s = 10\mu F$   
 $VR_1 = 500\Omega$   
 (these values are the same for both bar and dot display)

Fig.2

● Attached components

(1) LED current setting resistor ( $R_1$ )

This resistor sets the LED current value. Refer to Fig. 3 for the relationship between the value of this resistor and the current value. The recommended value is  $27k\Omega$  for green LEDs, and  $39k\Omega$  for red LEDs.

If the LED current is set too high, the allowable power dissipation of the package may be exceeded, so exercise due caution.

(2) Input coupling capacitor ( $C_1$ )

This capacitor connects the BA681A to external input circuits. The recommended value is  $2.2\mu F$ .

(3) Input bias resistor ( $R_2$ )

This resistor is the input impedance. If the value is set too large, the DC bias voltage will increase, and the input offset will increase and have an effect on the comparators. The recommended value is  $10k\Omega$ .

(4) Resistor and capacitor that set the LED operation level discharge time constant ( $R_3$  and  $C_2$ )

These components set the discharge time constant for LED operation level. The recommended values are  $R_3 = 10\text{k}\Omega$  and  $C_2 = 10\mu\text{F}$ .

(5) Input offset adjustment resistors ( $R_4$  and  $VR_1$ )

These resistors are used to adjust the input offset for the rectifier amplifier.

The recommended values are  $R_4 = 240\text{k}\Omega$ , and  $VR_1 = 500\Omega$ . If the value of  $VR_1$  is too high, adjustment becomes difficult, and if it is too small, adjustment may not be possible.

(6) Power supply capacitor ( $C_3$ )

This capacitor stabilizes the power supply line.

The recommended value is  $10\mu\text{F}$ . This capacitor will have no effect if its value is  $1\mu\text{F}$  or less.

#### ● Operation notes

(1) LED connection

Connect the LEDs as indicated in Fig. 2. Note that the connection methods are different for bar and dot displays, and that in the case of bar display, pin 18 is open, while for dot display, pin 18 is connected to GND.

When using different color LEDs that have different current values (e.g. green for the lower 10 LEDs and red for the top two) set the value of the current to the larger LED current using the external resistor, and adjust the current value for LEDs that require a smaller current by connecting resistors in parallel them. If you wish to remove LEDs, do so from the lowest level (except when the 12th LED is not used for display alignment).

Be certain to short unused LEDs.

(2) LED current adjustment

The LED current is set using  $R_1$ . The relationship between the value of  $R_1$  and the typical LED current is given in Fig. 3.

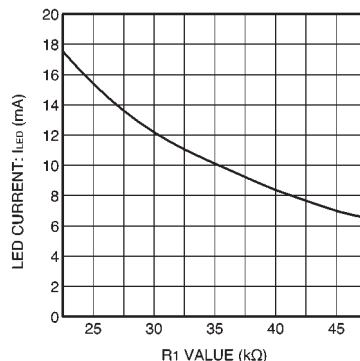


Fig. 3 LED current vs.  $R_1$  setting

(3) Comparator voltage

In the case of the BA681A, the comparator voltage is the input voltage when about half LED current setting value (Typ.) is flowing in an LED.

Therefore, if the LED current is set to  $16\text{mA}$ , the comparator voltage is the value when  $8\text{mA}$  is flowing in the LED.

(4) 0dB and input offset adjustment

First, adjust the input signal so that the 10th LED lights. This is the 0dB input signal level. Next, lower the input signal level to  $-27\text{dB}$ , and adjust the offset adjustment potentiometer  $VR_1$  so that the 2nd LED lights.

Repeat the 0dB and  $-27\text{dB}$  adjustments alternately to accurately set the levels.

The input level at which an LED lights is the comparator voltage.

(5) The BA681A GND (pin 9) and the external component earths should be connected together at one point.

(6) Application example (display)

LED Display	V 12	V 11	V 10	V 9	V 8	V 7	V 6	V 5	V 4	V 3	V 2	V 1
50W class	100 W	50 W	25 W	10 W	5 W	2.5 W	1 W	0.5 W	0.25 W	0.1 W	0.05 W	0.03 W
50W class	— *	100 W	50 W	20 W	10 W	5 W	2 W	1 W	0.5 W	0.2 W	0.1 W	— *
100W class	200 W	100 W	50 W	20 W	10 W	5 W	2 W	1 W	0.5 W	0.2 W	0.1 W	0.06 W
200W class	400 W	200 W	100 W	40 W	20 W	10 W	4 W	2 W	1 W	0.5 W	— *	— *

\* Location of unused LEDs.

●Tape deck application example

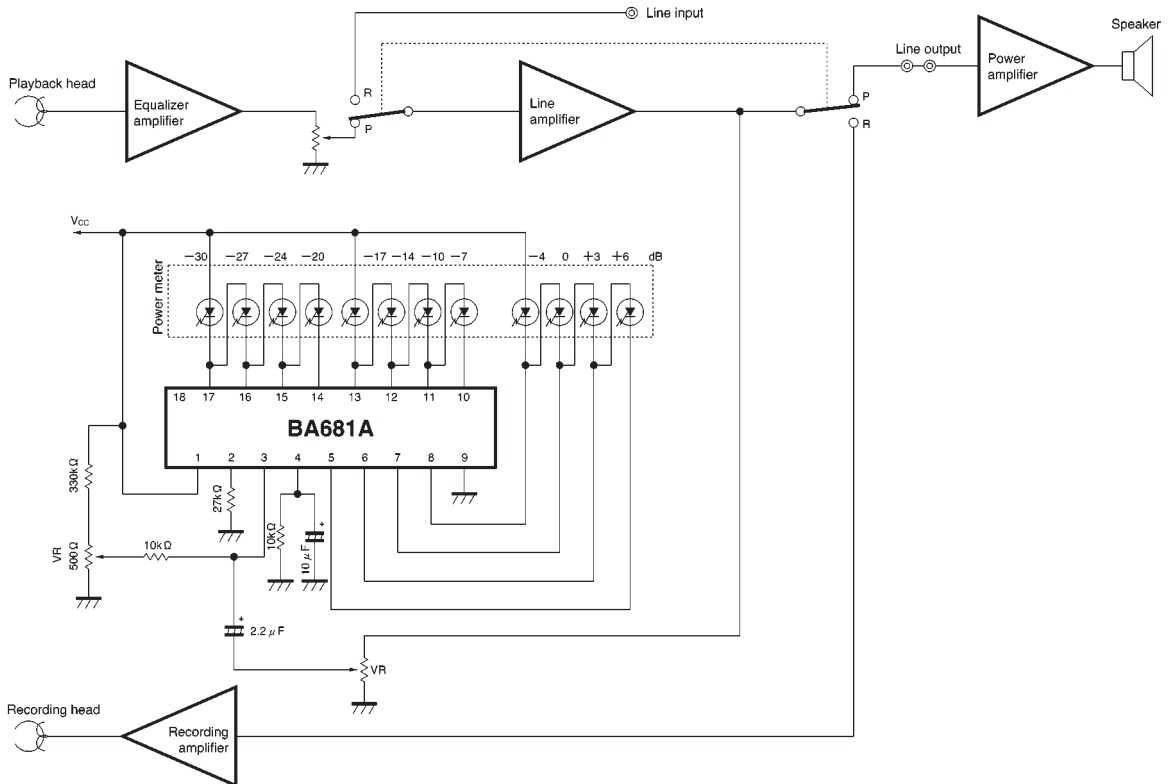


Fig. 4

● External dimensions (Units: mm)

