

Dimensions (mm)

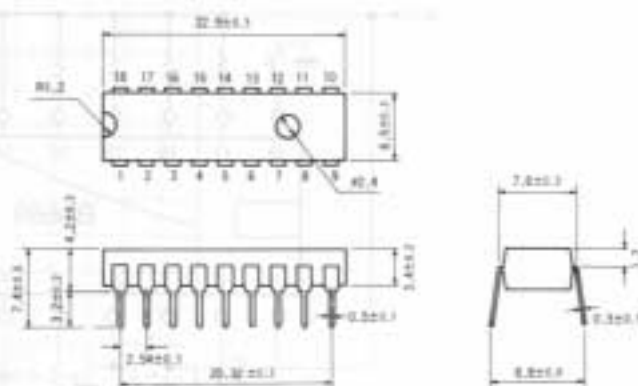


Fig. 1

The BA689 is a monolithic integrated circuit consisting of an LED level meter driver. The display level range is 0 ~ 300mVrms (typical), displayed as 12 equal steps of 25mVrms, thus achieving a linear display.

Constant-current sink-type outputs are used and the current value may be adjusted by means of an externally connected resistor, thus enabling the drive of all red or all green LED displays or mixed color displays.

Features

1. 12-Point power meter display in bar or dot format is selectable.
2. Constant-current sink output is used and direct LED drive is possible.
3. LED current can be adjusted externally to suit the type of LED used.
4. Built-in half-wave rectifying amplifier
5. LED lighting and extinguishing times are adjustable by means of externally connected resistors and capacitors.
6. Four LEDs are connected in series to form a bar-type display, thus achieving a savings in power.

Applications

1. Signal meters
2. Battery checkers
3. Temperature indicators for air conditioners and other products

Block Diagram

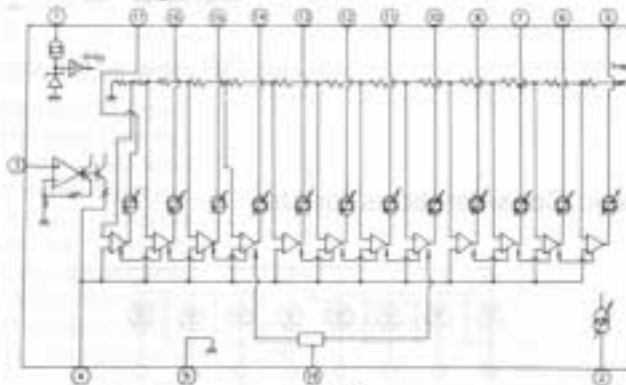


Fig. 2

Electrical Characteristics

($T_a = 25^\circ\text{C}$, $V_{CC} = 12\text{V}$, $f = 1\text{kHz}$)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions	Test circuit
Supply voltage	V_{CC}	10	12	14	VDC	LED $V_f = 2.0\text{V}$	Fig. 3
Supply current	I_{CC}	—	5	10	mA	$V_{in} = 0$	Fig. 3
LED Current-setting range	I_{LED}	—	—	20	mA	Adjusted with RT (see Fig. 5)	Fig. 3
Pin 5 LED current	I_{LED5}	12	16	20	mA	$R_1 = 27\text{k}\Omega$	Fig. 3
Difference in currents between LEDs	I_{diff}	-2.0	0	+2.0	mA	$R_1 = 27\text{k}\Omega$, with respect to pin 5 (I_{LED5})	Fig. 3
Sensitivity		160	250	320	mVrms	$f = 1\text{kHz}$, pin 7 output on-state level	Fig. 5
Comparator level 1	V_{C1}	0.05	0.10	0.15		Pin 17 output with respect to V_{CC}	Fig. 3
Comparator level 2	V_{C2}	0.15	0.20	0.25		Pin 16 output with respect to V_{CC}	Fig. 3
Comparator level 3	V_{C3}	0.25	0.30	0.35		Pin 15 output with respect to V_{CC}	Fig. 3
Comparator level 4	V_{C4}	0.35	0.40	0.45		Pin 14 output with respect to V_{CC}	Fig. 3
Comparator level 5	V_{C5}	0.45	0.50	0.55		Pin 13 output with respect to V_{CC}	Fig. 3
Comparator level 6	V_{C6}	0.55	0.60	0.65		Pin 12 output with respect to V_{CC}	Fig. 3
Comparator level 7	V_{C7}	0.65	0.70	0.75		Pin 11 output with respect to V_{CC}	Fig. 3
Comparator level 8	V_{C8}	0.75	0.80	0.85		Pin 10 output with respect to V_{CC}	Fig. 3
Comparator level 9	V_{C9}	0.85	0.90	0.95		Pin 9 output with respect to V_{CC}	Fig. 3
Comparator level 10	V_{C10}	—	1	—		Pin 7 output V_{C10} taken as 1	Fig. 3
Comparator level 11	V_{C11}	1.05	1.10	1.15		Pin 6 output with respect to V_{CC}	Fig. 3
Comparator level 12	V_{C12}	1.15	1.20	1.25		Pin 5 output with respect to V_{CC}	Fig. 3

*1. Adjustment should be made at the level at which the 12th point lights. If the input adjustment is not made, the values given above will vary slightly.

*2. When using circuit constants different than those recommended, the values given above will vary slightly.

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Limits	Unit
Supply voltage	V_{CC}	15	V
Power dissipation	P_D	1100*	mW
Operating temperature	T_{op}	-25~+60	$^\circ\text{C}$
Storage temperature	T_{stg}	-55~+125	$^\circ\text{C}$

* Detering is done at 11mW/ $^\circ\text{C}$ for operation above $T_a = 25^\circ\text{C}$.

Test Circuit

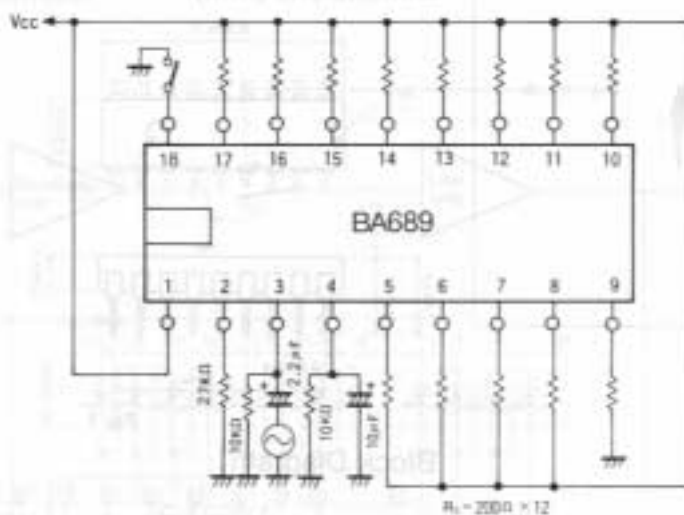
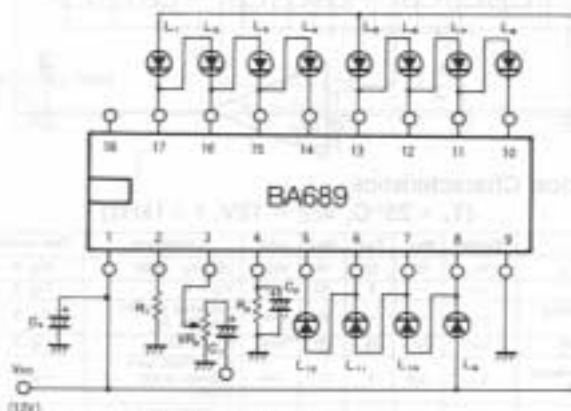


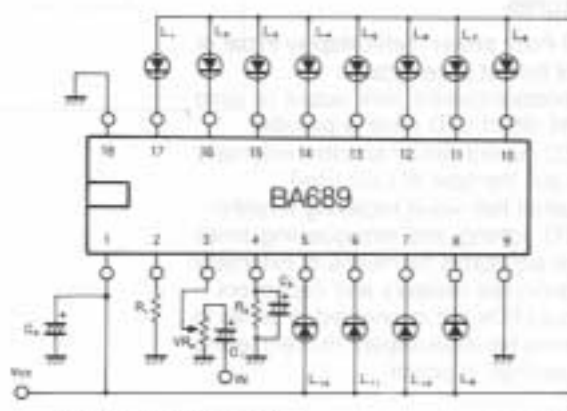
Fig. 3

Basic Considerations for Use



(1) Bar-type display connection

Note: The LED power output terminals (pins 5 - 8 and 10 - 17) should always be kept at a potential over 2V. If used at below 2V, output current will greatly decrease. For a bar-type display, LEDs with a high V_F value should be used.



(2) Dot-type display connection

(Recommended values)

$R_1 = 27\text{k}\Omega$ (Green LEDs) or $39\text{--}47\text{k}\Omega$ (Red LEDs)

$VR_2 = 10\text{k}\Omega$, $C_1 = 2.2\mu\text{F}$

$R_3 = 10\text{k}\Omega$, $C_2 = 10\mu\text{F}$

$C_3 = 10\mu\text{F}$

(These values are the same for the dot- and bar-type displays.)

Fig. 4 Basic connection examples

Externally Connected Components

1. LED Current Setting Resistor: R_1

This resistor sets the LED drive current, and should be chosen using Fig. 5. The recommended values are $27\text{k}\Omega$ for green LEDs and $39\text{k}\Omega$ for red LEDs.

Care should be taken not to set the

LED drive current excessively high, as this could result in exceeding the power dissipation specifications for the LED.

2. Input Coupling Capacitor: C_1

This capacitor is used to couple the BA688A to an external circuit. The

recommended value is $2.2\mu\text{F}$.

3. Input Bias Resistor: R_2

A variable resistor should be used here to provide input level adjustment.

The value of this resistor becomes the input impedance of the BA688. If

this value is made too high, the DC bias voltage will increase, and the input offset value will increase, thus affecting the comparator levels. The recommended value is 10kΩ.

4. LED Operating Level Discharge Time Constant Determining Resistor and Capacitor: R_3 , C_2

This resistor and capacitor determine the time constant for discharge at the various LED levels. The recommended values are 10kΩ and 10μF.

5. Power Supply Capacitor: C_1

This capacitor is used to provide regulation on the power supply line. The recommended value is 10μF. The regulating effectiveness drops significantly at values of 1μF or below.

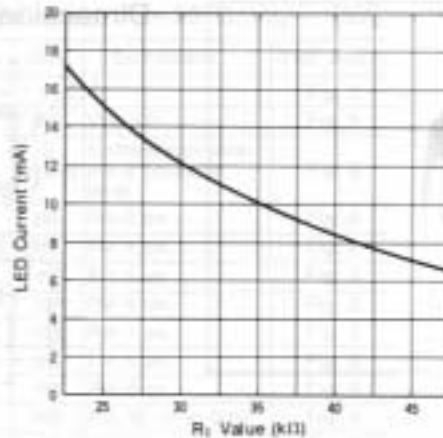


Fig. 5 R₁ Value vs. LED drive current

Precautions for Use

1. LED Connections

LED connections should be made as shown in Fig. 4. Note that the method of connection depends on whether a bar- or dot-type display is to be implemented, pin 18 being left open for bar display and grounded for dot display. When driving LEDs of different colors requiring different currents (e.g. the lower 10 green and the upper 2 red), the current value for the higher current LED should be determined by an external resistor, and the LED passing the smaller current should be paralleled with a resistance. When removing LEDs, remove the lower level LEDs first (with the exception of 12th LED to adjust the display). Unused LEDs must be shorted.

2. LED Current Setting

The LED current is set using R_1 , with the typical values shown in Fig. 5 as a guide.

3. Comparator Voltages

In the BA689, the comparator voltage is taken as that input voltage at which the LED current is one-half the set value (typical). Therefore, if the set LED current value is 16mA, the comparator voltage is that voltage which causes 8mA to flow.

Application Example (Use with DC Input)

When operating the BA689 with DC input, pin 3 may be used as the input (see Fig. 6). However, when the input level increases, input may be made directly at the AMP OUT pin (pin 4). Use of this pin (see Fig. 7) eliminates the effect of amplifier gain variations, thus significantly reducing variations in comparator levels. If the value of the 100kΩ variable resistor in Fig. 7 is made small, the discharge time constant determined by R_1 and C_1 will change, thus changing the response time.

The maximum input level for pin 4 is 6V.

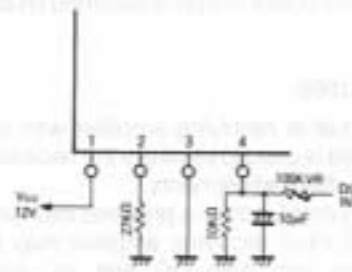


Fig. 7

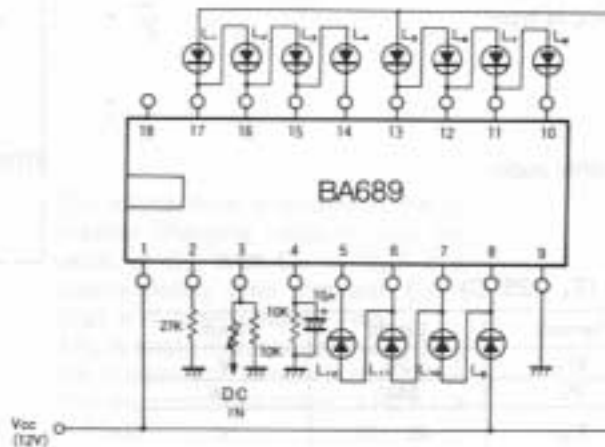


Fig. 6

Comparator level	V _{c1}	V _{c2}	V _{c3}	V _{c4}	V _{c5}	V _{c6}	V _{c7}	V _{c8}	V _{c9}	V _{c10}	V _{c11}	V _{c12}	Unit
Pin 4 DC input	0.35	0.69	1.04	1.38	1.73	2.07	2.42	2.76	3.11	3.45	3.80	4.14	V

(Typical values)