

LED level meter driver, 12-point × 2 channel, VU scale, bar display

BA6820F / BA6822S / BA6822F

The BA6820F, BA6822S and BA6822F are two-channel, 12-point LED drivers for VU-scale bar-level meters. The ICs are available in 22-pin SOP (BA6820F and BA6822F) and 22-pin shrink-DIP (BA6822S) packages, and use a dynamic-drive system that can drive two 12-point displays. The ICs have independent AC and DC inputs, and the AC input mode has a peak hold circuit (with cancel function). The ICs also feature a power-on mute, so steps to prevent erroneous LED lighting at power on are not required.

The input resistance of the AC inputs is 3k Ω (Typ.) for the BA6820F and 0.3k Ω (Typ.) for the BA6822S/F.

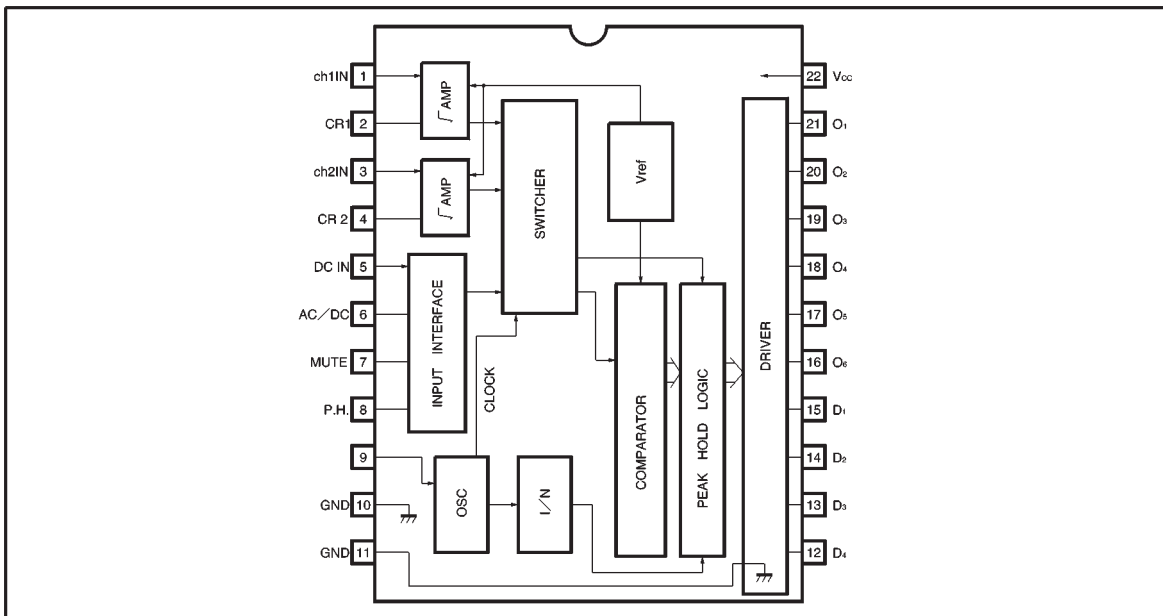
●Applications

Level meters for VCRs, stereo cassette players, audio amplifiers and karaoke equipment.

●Features

- 1) Uses dynamic-drive system to display two 12-point channels. 22-pin SOP and 22-pin shrink DIP packages.
- 2) Independent AC and DC inputs provided (one input displays one channel). Switching function allows two-mode display.
- 3) Upper 8 points have peak hold function in AC mode (two seconds). A peak-hold cancel function is also provided.
- 4) A mute function is provided, and muting can be applied externally.
- 5) Power on mute function.

●Block diagram



●Absolute maximum ratings

(BA6820F/BA6822F) (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V _{CC}	7.0	V
Power dissipation	P _d	450*	mW
Operating temperature	T _{opr}	-20~+70	°C
Storage temperature	T _{stg}	-55~+125	°C
Maximum output driver current	I _{OM}	40	mA
Maximum display switch driver current	I _{DM}	20	mA

* Reduced by 4.5mW for each increase in Ta of 1°C over 25°C.

(BA6822S) (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V _{CC}	7.0	V
Power dissipation	P _d	1000*	mW
Operating temperature	T _{opr}	-20~+70	°C
Storage temperature	T _{stg}	-55~+125	°C
Maximum output driver current	I _{OM}	60	mA
Maximum display switch driver current	I _{DM}	30	mA

* Reduced by 10mW for each increase in Ta of 1°C over 25°C.

●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Oscillator frequency	f _{osc}	—	4	—	kHz	C=0.01 μF R=41kΩ

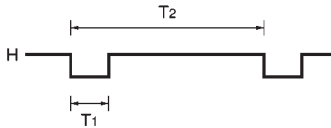
●Electrical characteristics (unless otherwise noted, Ta = 25°C, V_{CC} = 5.0V and f = 1kHz)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	
Operating power supply voltage	V _{CC}	4.5	5.0	5.5	V	—	
Quiescent current	I _Q	—	10	15	mA	Not input, when output off	
〈1 / 2 divider amplifier 1〉							
Quiescent input voltage	V _{OO}	—	30	100	mV	I _{IN} =0, R _L =47kΩ	
Input resistance	BA6820F	R _{IN}	2	3	4	kΩ	—
	BA6822S/F		0.2	0.3	0.4		
Output voltage	BA6820F	V _{OUT}	600	1000	1400	mV	I _{IN} =-100 μA R _L =47kΩ
	BA6822S/F		500	890	1400		
Maximum input current	I _{IM}	1.2	2	—	mA	—	
Crosstalk	CT	—	40	120	mV	V _{IN} =1.8Vrms	
Differential output voltage	ΔV _{OUT}	-250	0	250	mV	I _{IN} =-100 μA, R _L =47kΩ	
Output voltage linearity	BA6820F	ΔV / ΔI	400	650	900	mV	I _{IN} =-10~-100 μA
	BA6822S/F		350	650	900		
〈DC input〉							
DC input resistance	R _{INDC}	30	50	70	kΩ	—	
〈Oscillator〉							
Oscillator frequency	f _{OSC}	3.5	4.0	4.5	kHz	C=0.01 μF, R=41kΩ	
〈Display output〉							
Peak hold time *1	T _{hold}	—	2	—	s	f _{osc} =4kHz	
Display switch output duty cycle	duty	—	7/32	—	—	—	
Display switch output low level voltage	V _{DL}	—	0.1	0.3	V	I _L =10mA, pins12 to15	
Display switch output leakage current	I _{leak}	—	—	10	μA	V _{CE} =5V, pins12 to15	
LED driver output low level voltage	V _{OL}	—	0.3	0.7	V	I _O =30mA, pins16 to21	
LED driver output leakage current	I _{leak}	—	—	10	μA	V _{CE} =5V, pins16 to21	
Mute time at power on	T _{mute}	—	1	—	s	f _{osc} =4kHz	
AC/DC switching threshold level	V _{TH6}	2.2	2.5	2.8	V	"H" ; AC, "L" ; DC6pin	
Forced mute input threshold	V _{TH7}	2.2	2.5	2.8	V	"H": mute (pin 7)	
Peak hold cancel input threshold	V _{TH8}	2.2	2.5	2.8	V	"H": cancel (pin 8)	
〈Comparator〉							
AC comparator level 12	V _{C12AC}	8.5	10	12	dB	Output: pin 16*3	
AC comparator level 11	V _{C11AC}	5.5	7	8.5	dB	Output: pin 16*3	
AC comparator level 10	V _{C10AC}	3.0	4	5.5	dB	Output: pin 17*3	
AC comparator level 9	V _{C9AC}	1.0	2	3.0	dB	Output: pin 17*3	
AC comparator level 8	V _{C8AC}	—	0	—	dB	Output: pin 18*3	
AC comparator level 7	V _{C7AC}	-3.0	-2	-1.0	dB	Output: pin 18*3	
AC comparator level 6	V _{C6AC}	-5.5	-4	-3.0	dB	Output: pin 19*3	
AC comparator level 5	V _{C5AC}	-8.5	-7	-5.5	dB	Output: pin 19*3	
AC comparator level 4	V _{C4AC}	-15	-10	-8.5	dB	Output: pin 20*3	
AC comparator level 3	V _{C3AC}	-25	-20	-15	dB	Output: pin 20*3	
AC comparator level 2	V _{C2AC}	-33	-30	-25	dB	Output: pin 21*3	
AC comparator level 1	V _{C1AC}	-55	-38	-33	dB	Output: pin 21*3	

Parameter		Symbol	Min.	Typ.	Max.	Unit	Conditions
AC sensitivity	BA6820F	V_{INAC}	170	308	450	mV _{rms}	AC comparator level 8 on level
	BA6822S/F		220	400	580		
DC comparator level 12		V_{C12DC}	2.78	3.10	3.44	V	Output: pin 16*4
DC comparator level 11		V_{C11DC}	2.35	2.64	2.90	V	Output: pin 16*4
DC comparator level 10		V_{C10DC}	1.98	2.23	2.48	V	Output: pin 17*4
DC comparator level 9		V_{C9DC}	1.75	2.00	2.25	V	Output: pin 17*4
DC comparator level 8		V_{C8DC}	1.50	1.76	2.00	V	Output: pin 18*4
DC comparator level 7		V_{C7DC}	1.35	1.58	1.85	V	Output: pin 18*4
DC comparator level 6		V_{C6DC}	1.20	1.42	1.65	V	Output: pin 19*4
DC comparator level 5		V_{C5DC}	1.00	1.18	1.35	V	Output: pin 19*4
DC comparator level 4		V_{C4DC}	0.80	1.00	1.15	V	Output: pin 20*4
DC comparator level 3		V_{C3DC}	0.35	0.51	0.70	V	Output: pin 20*4
DC comparator level 2		V_{C2DC}	0.15	0.25	0.35	V	Output: pin 21*4
DC comparator level 1		V_{C1DC}	0.05	0.11	0.20	V	Output: pin 21*4

* 1 Peak hold for comparator levels for 5 to 12. There is no peak hold for DC input.

* 2 Display switch output duty cycle.



Display switch output duty cycle = T_1/T_2

* 3 The reference value for the AC comparator is the level of comparator 8.

* 4 Only ch2 is effective in DC input mode.

● Measurement circuit

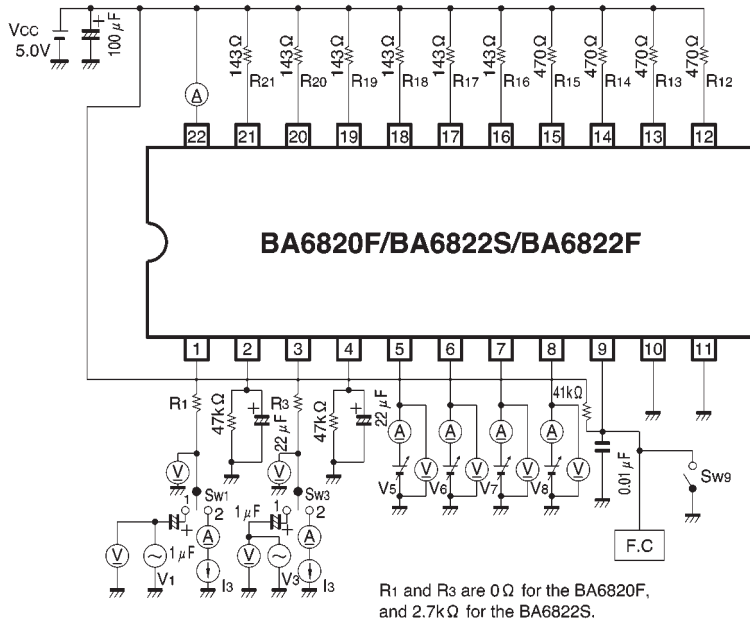


Fig. 1

● Application example

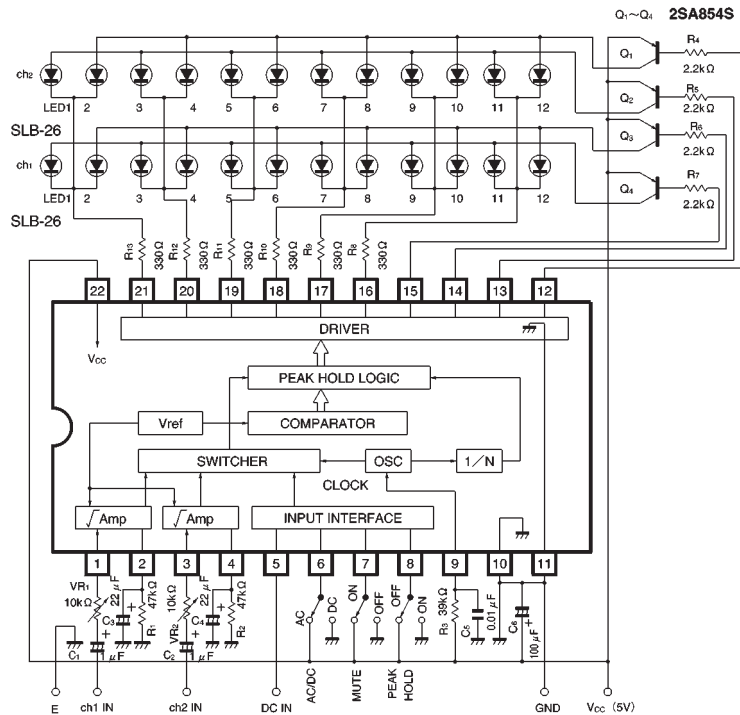


Fig. 2

● Attached components

• C_1 and C_2 : $1\mu\text{F}$ input coupling capacitors (electrolytic) for the square-root compression amplifier. The rectified voltage output from pins 2 and 4 is attenuated by 1.5dB at the frequency determined by the following formula (refer to the data for the relationship between the pin 2 and 4 DC voltage frequency characteristics and the LED lighting level).

$$f_C = \frac{1}{2\pi \cdot C_1 (R_{IN} + VR_1)} \quad (R_{IN} = \text{input resistance})$$

$$\frac{7}{32}$$

When the LEDs light due to low-frequency mechanical noise or induced hum, reduce the values of C_1 and C_2 to cut the low-frequency frequency characteristic.

• VR_1 and VR_2 : $5\text{k}\Omega$ to $100\text{k}\Omega$

$$\frac{V_{CC} - V_{LED} - V_{sat}(Q_1 - Q_4) - V_{DL}}{I_{LED}}$$

(3) Peak hold

The peak hold circuit momentarily holds the maximum signal level in AC input mode. The peak hold function applies to comparator levels 5 to 12 (8 points). When the oscillator frequency is 4kHz, the peak hold time is two seconds (Typ.), and can be changed by changing the oscillator frequency. The peak hold function can be turned off by setting pin 8 high.

The peak hold function does not operate in DC input mode.

(4) Output block

The two sets of 12 LEDs for the BA6820F and BA6822S/F are divided into 4 groups of six. A dynamic-drive technique is used to drive the LEDs in order, and display the input level.

Group 1

Channel 1 LEDs 1, 3, 5, 7, 9 and 11
(odd-numbered LEDs)

Group 2

Channel 1 LEDs 2, 4, 6, 8, 10 and 12
(even-numbered LEDs)

Group 3

Channel 2 LEDs 1, 3, 5, 7, 9 and 11
(odd-numbered LEDs)

Group 4

Channel 2 LEDs 2, 4, 6, 8, 10 and 12
(even-numbered LEDs)

Therefore, six LED drive outputs, and four display switch terminals are provided.

The output timing chart for when all LEDs are lit is shown in Fig. 3.

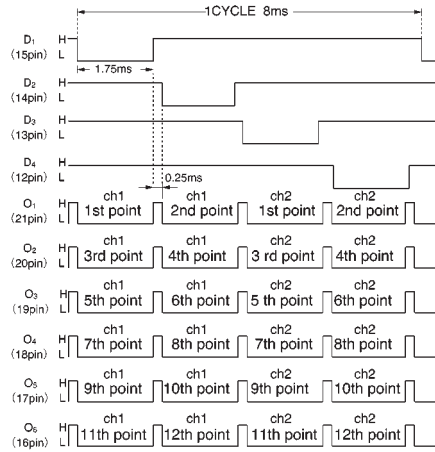
In DC input mode, only channel 2 operates.

D₁ to D₄ in the timing chart operate in the same way as for AC mode (i.e. D₁ and D₂ operate), but O₁ to O₆ are high for the channel 1 period.

1) Display switch outputs (pins 12 to 15)

To successively switch between the four LED groups, these outputs are active low (see Fig. 4).

The outputs are pulled up by 36kΩ resistors (between the base and emitter of Q₁ to Q₄), so leak current bypass resistors are not required.



Timing chart for all LEDs on (f = 4kHz)

Fig. 3

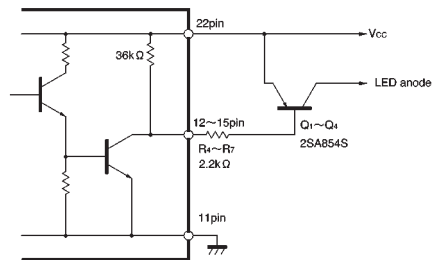


Fig. 4

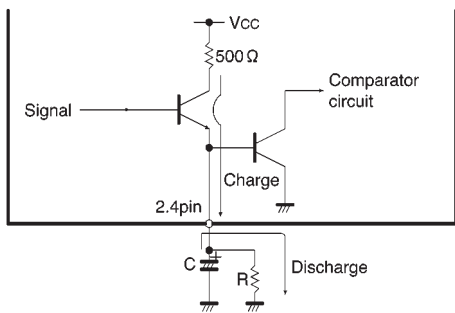


Fig. 7

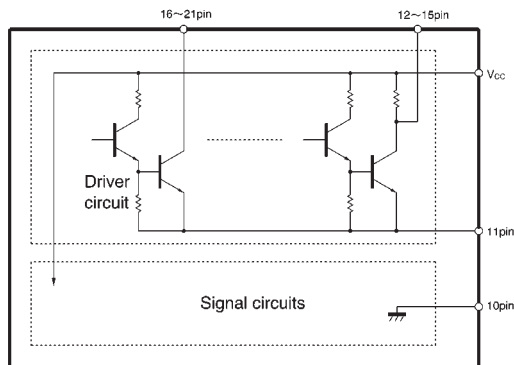


Fig. 8

(8) GND terminal (pins 10 and 11)

Pin 11 is the GND for the pin 12 to pin 21 driver circuits, and pin 10 is the GND for the other signal circuits (see Fig. 8).

Pins 10 and 11 are not connected internally, so both must be connected to GND.

The large LED current that flows from pin 11 has a large high-frequency component, so care must be taken with regard to the PCB layout to avoid faulty operation of the IC, and incorrect lighting of the LEDs due to noise.

● Operation notes

(1) Use the potentiometers VR1 and VR2 connected to pins 1 and 3 to set the 0dB levels and adjust the channel 1 and channel 2 balance.

(2) The recommended oscillator frequency is 4kHz (pin 9). The external component values for C_5 and R_3 are $0.01\mu\text{F}$ and $41\text{k}\Omega$ (or $39\text{k}\Omega$). If you wish to use other values, they should be in the ranges $0.001\mu\text{F}$ to $0.1\mu\text{F}$ and $10\text{k}\Omega$ to $100\text{k}\Omega$. (see Fig. 9).

(3) The dynamic ranges for the BA6820F and BA6822S/F comparators are large, and the comparators will operate even with low-level signals.

For this reason, noise may cause the LEDs to light when they should not, and to prevent this, GND line noise should be kept sufficiently low.

(4) Take care to ensure the none of the pins have a voltage applied to them that is higher than V_{CC} or lower than GND (e.g. supply the LED current from a source other than V_{CC}).

(5) In general, the level meter output block is switched on and off in the range GND to V_{CC} , and a large voltage with a large high-frequency component is generated.

Therefore, if the input and output lines are close, the out-

put may be fed back to the input and cause oscillation, incorrect LED lighting, or faulty operation of the IC. Design the PCB artwork so that there is no coupling between the input and output lines or with other units, in the same way as for linear amplifier PCB design. If they must be physically close, insert a capacitor between the input and GND to reduce the AC input impedance, and prevent noise from entering the input.

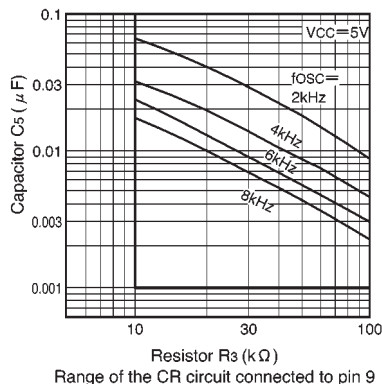


Fig. 9

●Electrical characteristic curves

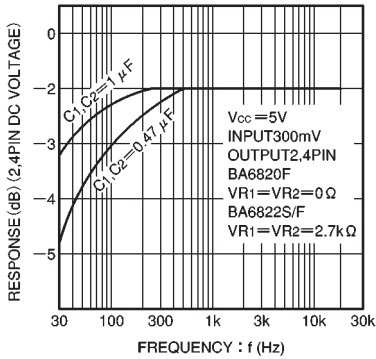


Fig. 10 Frequency characteristics

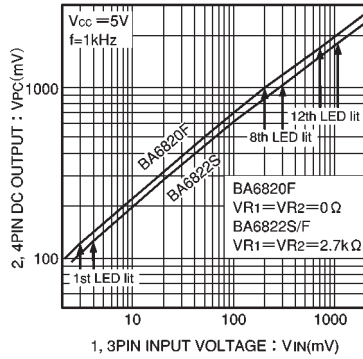


Fig. 11 Pin 2 and pin 4 DC output voltage vs. pin 1 and pin 3 AC input voltage

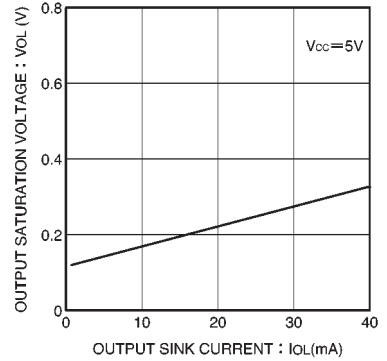


Fig. 12 Output saturation voltage vs. sink current (LED output)

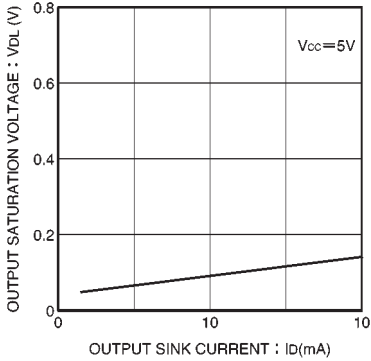


Fig. 13 Output saturation voltage vs. sink current (display switch output)

●External dimensions (Units: mm)

