

# AN8001FHK

## Gradation voltage generation IC for liquid crystal display

### ■ Overview

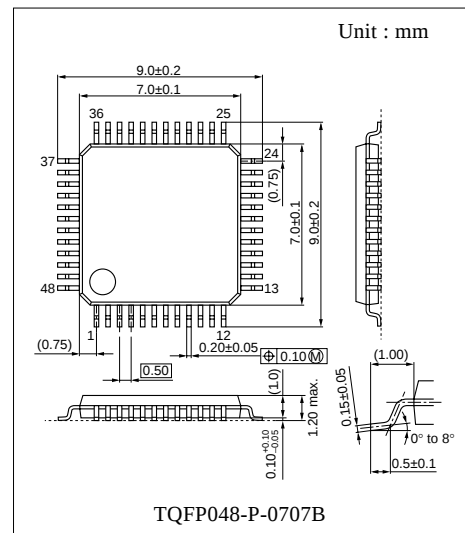
The AN8001FHK is a gradation voltage generation IC for liquid crystal displays and designed for 64-gradation LCDs. It is incorporating an 1.23 V reference voltage circuit, 10 gradation output buffer amplifier circuits, and a COM amplifier circuit.

### ■ Features

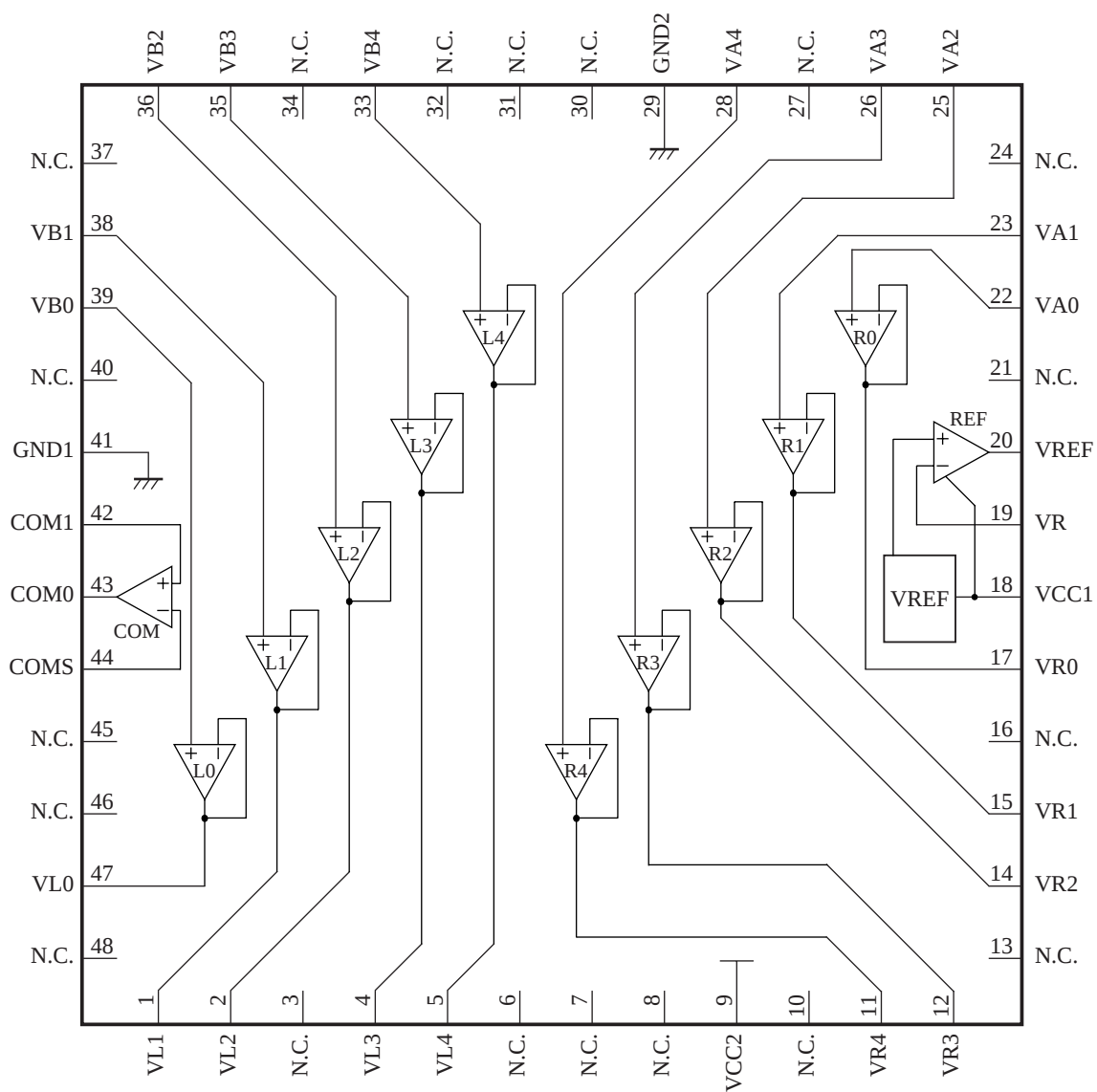
- Incorporating a high precision reference voltage source : 1.23 V (typ.)
- Wide dynamic range of buffer amplifiers and it is possible to provide an output from  $V_{CC} - 0.2$  V (the highest stage) to GND + 0.2 V (the lowest stage).
- Large COM-amplifier drive current :  $\pm 100$  mA (max.)

### ■ Applications

- Gradation power supply source for LCDs



■ Block Diagram



Top View

### ■ Absolute Maximum Ratings

| Parameter                                                 | Symbol        | Rating                                 | Unit |
|-----------------------------------------------------------|---------------|----------------------------------------|------|
| Supply voltage                                            | $V_{CC}$      | 14.2                                   | V    |
| Supply current                                            | $I_{CC}$      | —                                      | mA   |
| REF amplifier output source current                       | $I_{Osource}$ | −5                                     | mA   |
| R0 amplifier output source current                        | $I_{O-R0}$    | −15                                    | mA   |
| R0 amplifier output sink current                          | $I_{O+R0}$    | 0.1                                    | mA   |
| R1 amplifier output source current                        | $I_{O-R1}$    | −15                                    | mA   |
| R1 amplifier output sink current                          | $I_{O+R1}$    | 0.1                                    | mA   |
| R/2/3/4, L2/3/4 amplifier output source current           | $I_{O-R2-L2}$ | −15                                    | mA   |
| R/2/3/4, L2/3/4 amplifier output sink current             | $I_{O+R2-L2}$ | 15                                     | mA   |
| L1 amplifier output source current                        | $I_{O-L1}$    | −0.05                                  | mA   |
| L1 amplifier output sink current                          | $I_{O+L1}$    | 15                                     | mA   |
| L0 amplifier output source current                        | $I_{O-L0}$    | −0.05                                  | mA   |
| L0 amplifier output sink current                          | $I_{O+L0}$    | 15                                     | mA   |
| COM amplifier output source current                       | $I_{O-COM}$   | −100                                   | mA   |
| COM amplifier output sink current                         | $I_{O+COM}$   | 100                                    | mA   |
| Power dissipation                                         | $P_D$         | 400* <sup>2</sup><br>220* <sup>3</sup> | mW   |
| Operating ambient temperature* <sup>1</sup>               | $T_{opr}$     | 0 to + 70                              | °C   |
| Storage temperature* <sup>1</sup>                         | $T_{stg}$     | −55 to + 150                           | °C   |
| REF amplifier maximum load capacitance                    | $C_{OREF}$    | 0.47                                   | mF   |
| R0/1/2/3/4, L4/3/2/1/0 amplifier maximum load capacitance | $C_{OR/L}$    | 0.1                                    | μF   |
| COM amplifier maximum load capacitance                    | $C_{OCOM}$    | 10                                     | μF   |

Note) Either current or voltage should not be applied from the outside to any terminals not specified.

For the circuit current, (+) is current flowing into the IC and (−) is current flowing out of the IC.

Set the input voltage of each amplifier within the range of the output voltage.

\*1 : All items are at  $T_a = 25^{\circ}\text{C}$ , except for the operating ambient temperature and storage temperature parameters.

\*2 :  $T_a = 25^{\circ}\text{C}$

\*3 :  $T_a = 70^{\circ}\text{C}$

### ■ Recommended Operating Range

| Parameter      | Symbol   | Range   | Unit |
|----------------|----------|---------|------|
| Supply voltage | $V_{CC}$ | 7 to 14 | V    |

■ Electrical Characteristics at  $T_a = 25^\circ\text{C}$

| Parameter                         | Symbol        | Conditions                                                                                  | Min                 | Typ  | Max               | Unit |
|-----------------------------------|---------------|---------------------------------------------------------------------------------------------|---------------------|------|-------------------|------|
| All device                        |               |                                                                                             |                     |      |                   |      |
| Circuit current                   | $I_{CC}$      |                                                                                             | —                   | 3.5  | 6                 | mA   |
| Reference voltage                 | $V_{REF}$     |                                                                                             | 1.19                | 1.23 | 1.27              | V    |
| Input bias current                | $I_B$         |                                                                                             | —                   | —    | 500               | nA   |
| REF amplifier block               |               |                                                                                             |                     |      |                   |      |
| Operating upper limit voltage 1   | $V_{H1}$      | Discharge current : 2 mA<br>Connect 0.1 $\mu\text{F}$ or more<br>for oscillation prevention | $V_{CC}$<br>− 0.2 V | —    | —                 | V    |
| Operating upper limit voltage 2   | $V_{H2}$      | Discharge current : 3 mA<br>Connect 0.1 $\mu\text{F}$ or more<br>for oscillation prevention | $V_{CC}$<br>− 0.3 V | —    | —                 | V    |
| Operating lower limit voltage     | $V_L$         | Connect 0.1 $\mu\text{F}$ or more<br>for oscillation prevention                             | —                   | —    | $V_{REF}$         | V    |
| R0 amplifier block                |               |                                                                                             |                     |      |                   |      |
| Output upper limit voltage 1      | $V_{H,R01}$   | Discharge current : 10 mA                                                                   | $V_{CC}$<br>− 0.2 V | —    | —                 | V    |
| Output upper limit voltage 2      | $V_{H,R02}$   | Discharge current : 15 mA                                                                   | $V_{CC}$<br>− 0.25V | —    | —                 | V    |
| Output lower limit voltage        | $V_{L,R0}$    | Sink current : 0.1 mA                                                                       | —                   | —    | $V_{CC}$<br>− 3 V | V    |
| Offset voltage                    | $V_{OFFR0}$   |                                                                                             | —                   | —    | 10                | mV   |
| R1 amplifier block                |               |                                                                                             |                     |      |                   |      |
| Output upper limit voltage        | $V_{H,R1}$    | Discharge current : 15 mA                                                                   | $V_{CC}$<br>− 0.7 V | —    | —                 | V    |
| Output lower limit voltage        | $V_{L,R1}$    | Sink current : 0.1 mA                                                                       | —                   | —    | $V_{CC}/2$        | V    |
| Offset voltage                    | $V_{OFFR1}$   |                                                                                             | —                   | —    | 10                | mV   |
| R2/R3/R4/L2/L3/L4 amplifier block |               |                                                                                             |                     |      |                   |      |
| Output upper limit voltage 1      | $V_{H,R2-R4}$ | Discharge current : 15 mA                                                                   | $V_{CC}$<br>− 1.5 V | —    | —                 | V    |
| Output lower limit voltage 1      | $V_{L,R2-R4}$ | Sink current : 15 mA                                                                        | —                   | —    | 2                 | V    |
| Output upper limit voltage 2      | $V_{H,L2-L4}$ | Discharge current : 15 mA                                                                   | $V_{CC}$<br>− 2 V   | —    | —                 | V    |
| Output lower limit voltage 2      | $V_{L,L2-L4}$ | Sink current : 15 mA                                                                        | —                   | —    | 1.5               | V    |
| Offset voltage                    | $V_{OFF234}$  |                                                                                             | —                   | —    | 10                | mV   |
| L1 amplifier block                |               |                                                                                             |                     |      |                   |      |
| Output upper limit voltage        | $V_{H,L1}$    | Discharge current : 50 $\mu\text{A}$                                                        | $V_{CC}/2$          | —    | —                 | V    |
| Output lower limit voltage        | $V_{L,L1}$    | Sink current : 15 mA                                                                        | —                   | —    | 0.7               | V    |
| Offset voltage                    | $V_{OFFL1}$   |                                                                                             | —                   | —    | 15                | mV   |

# ■ Electrical Characteristics at $T_a = 25^\circ\text{C}$

| Parameter                  | Symbol       | Conditions                           | Min                | Typ | Max | Unit |
|----------------------------|--------------|--------------------------------------|--------------------|-----|-----|------|
| L0 amplifier block         |              |                                      |                    |     |     |      |
| Output upper limit voltage | $V_{H, L0}$  | Discharge current : 50 $\mu\text{A}$ | 3                  | —   | —   | V    |
| Output lower limit voltage | $V_{L, L0}$  | Sink current : 15 mA                 | —                  | —   | 0.2 | V    |
| Offset voltage             | $V_{OFFL0}$  |                                      | —                  | —   | 15  | mV   |
| COM amplifier block        |              |                                      |                    |     |     |      |
| Output upper limit voltage | $V_{H, COM}$ | Discharge current : 100 mA           | $V_{CC}$<br>-2.5 V | —   | —   | V    |
| Output lower limit voltage | $V_{L, COM}$ | Sink current : 100 mA                | —                  | —   | 2.5 | V    |
| Offset voltage             | $V_{OFFCOM}$ |                                      | —                  | —   | 10  | mV   |

## • Design reference data

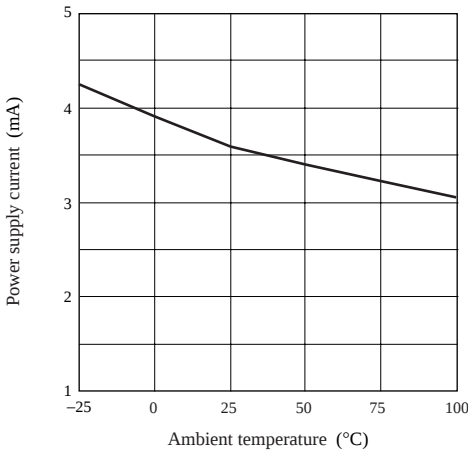
Note) The following characteristics are the reference values for design and not guaranteed values.

| Parameter                                                  | Symbol                     | Conditions                                                                             | Min | Typ | Max | Unit          |
|------------------------------------------------------------|----------------------------|----------------------------------------------------------------------------------------|-----|-----|-----|---------------|
| Recovery time                                              | Ri-Time<br>COM             |                                                                                        | —   | —   | 2   | $\mu\text{S}$ |
| REF amplifier block<br>Supply voltage rejection ratio      | $\text{PSRR}_{\text{REF}}$ | $f = 10 \text{ kHz to } 500 \text{ kHz}$<br>200 mV[p-p], 0.1 $\mu\text{F}$ connection  | —   | —   | -40 | dB            |
| R0 amplifier block<br>Supply voltage rejection ratio       | $\text{PSRR}_{R0}$         | $f = 10 \text{ kHz to } 500 \text{ kHz}$<br>200 mV[p-p], 0.01 $\mu\text{F}$ connection | —   | —   | -10 | dB            |
| R1 amplifier block<br>Supply voltage rejection ratio       | $\text{PSRR}_{R1}$         | $f = 10 \text{ kHz to } 500 \text{ kHz}$<br>200 mV[p-p], 0.01 $\mu\text{F}$ connection | —   | —   | -20 | dB            |
| R2/R3R/4 amplifier block<br>Supply voltage rejection ratio | $\text{PSRR}_{R234}$       | $f = 10 \text{ kHz to } 500 \text{ kHz}$<br>200 mV[p-p], 0.01 $\mu\text{F}$ connection | —   | —   | -40 | dB            |
| R2/R3R/4 amplifier block<br>Supply voltage rejection ratio | $\text{PSRR}_{L234}$       | $f = 10 \text{ kHz to } 500 \text{ kHz}$<br>200 mV[p-p], 0.01 $\mu\text{F}$ connection | —   | —   | -40 | dB            |
| L1 amplifier block<br>Supply voltage rejection ratio       | $\text{PSRR}_{L1}$         | $f = 10 \text{ kHz to } 500 \text{ kHz}$<br>200 mV[p-p], 0.01 $\mu\text{F}$ connection | —   | —   | -10 | dB            |
| L0 amplifier block<br>Supply voltage rejection ratio       | $\text{PSRR}_{L0}$         | $f = 10 \text{ kHz to } 500 \text{ kHz}$<br>200 mV[p-p], 0.01 $\mu\text{F}$ connection | —   | —   | -20 | dB            |
| COM amplifier block<br>Supply voltage rejection ratio      | $\text{PSRR}_{\text{COM}}$ | $f = 10 \text{ kHz to } 500 \text{ kHz}$<br>200 mV[p-p], 0.1 $\mu\text{F}$ connection  | —   | —   | -40 | dB            |

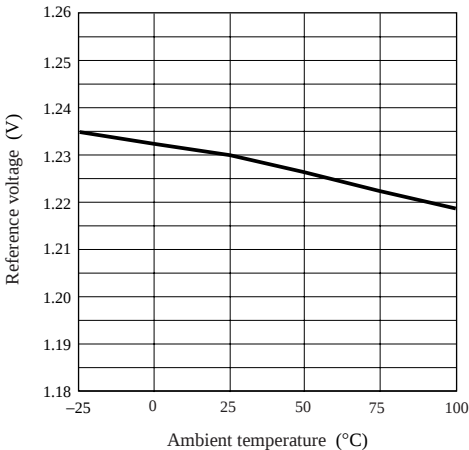
■ Technical Data

• Characteristics curve

Power supply current — temperature characteristics  
( $I_{CC} - T_a$ )

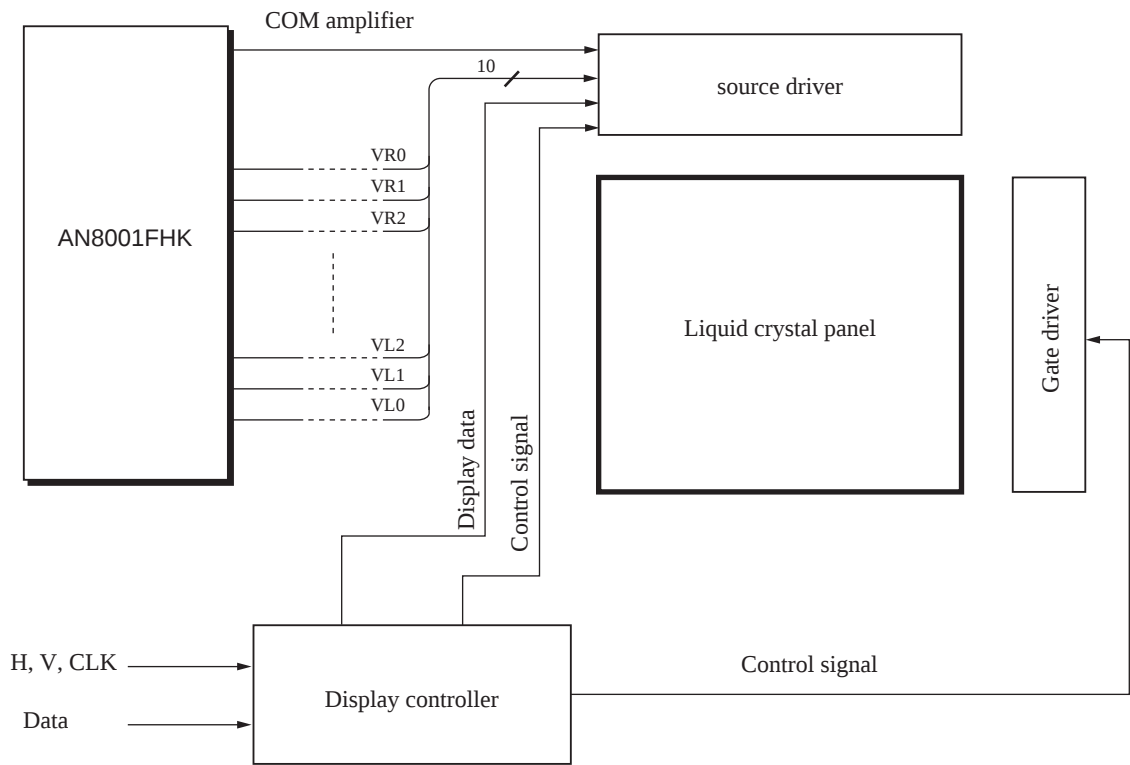


Reference voltage — temperature characteristics  
( $V_{REF} - T_a$ )



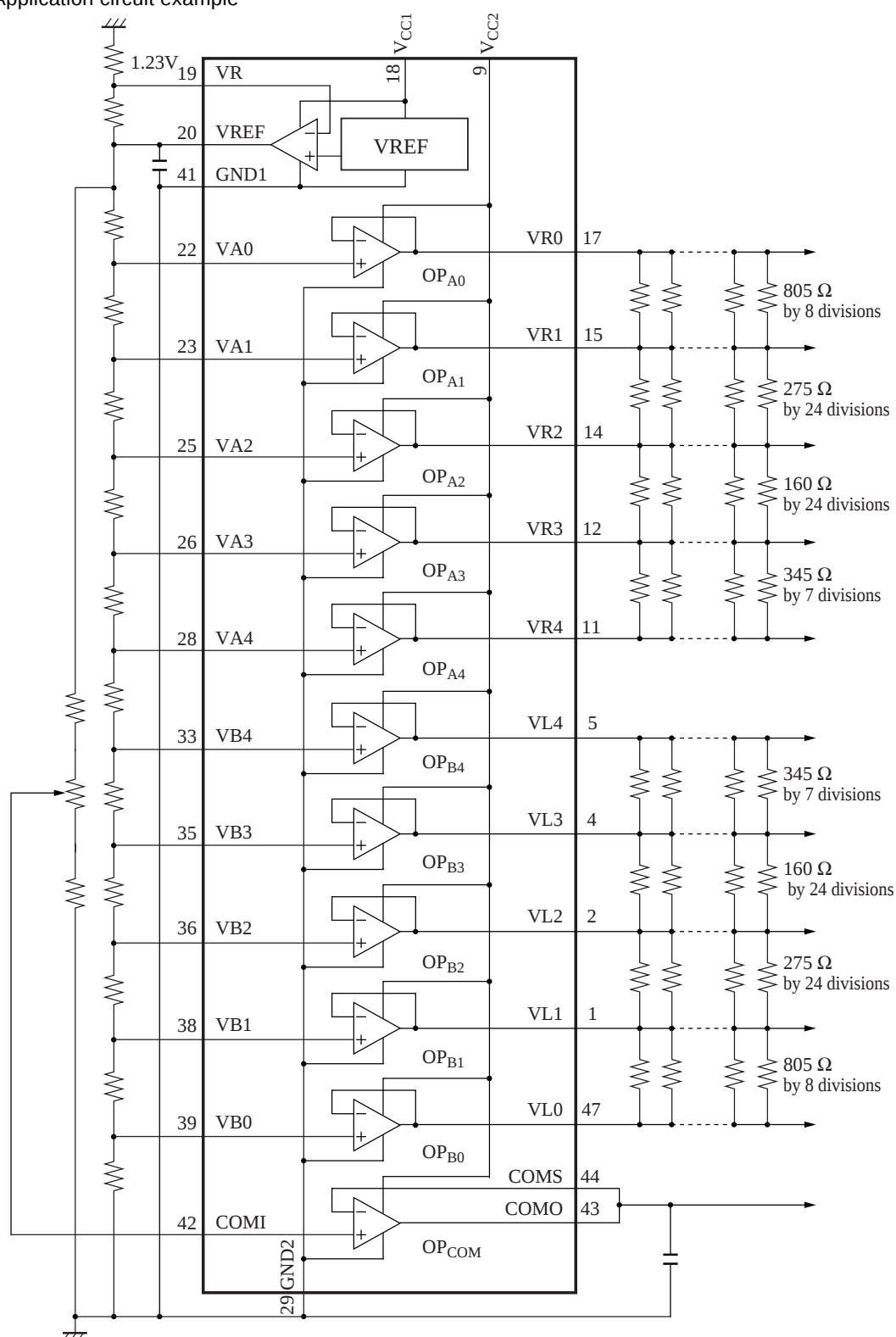
■ Application Example

• System configuration example



# Application Example (continued)

## Application circuit example



# ■ Application Example (continued)

<Recommended operating conditions>

| Parameter        | Symbol     | Ratings  | Unit    | Notes      |
|------------------|------------|----------|---------|------------|
| Supply voltage   | $V_{CC}$   | 10.5     | V       |            |
| Load capacitance | $C_{LOAD}$ | 0.01     | $\mu F$ | VR0 to VL0 |
|                  |            | 0.1 to 1 | $\mu F$ | COM0       |
|                  |            | 0.1      | $\mu F$ | $V_{REF}$  |

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

Мы предлагаем:

- Конкурентоспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



Тел: +7 (812) 336 43 04 (многоканальный)

Email: [org@lifeelectronics.ru](mailto:org@lifeelectronics.ru)

[www.lifeelectronics.ru](http://www.lifeelectronics.ru)