# AN1702FHK

## Gray-scale voltage generating IC for liquid crystal display

### ■ Overview

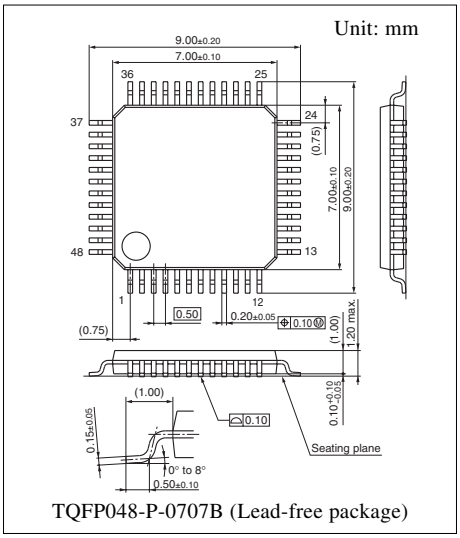
The AN1702FHK has been designed for LCD applications,and features built-in functions such as a gray-scale voltage generatior that supports 256 gradations, a reference voltage of 1.23 V, 16 output buffer amp circuits and a COM amplifier circuit.

### ■ Features

- Built-in 1.23 V (typical) high-precision reference voltage power source
- Wide buffer amp. dynamic range output: $V_{CC}$ − 0.2 V (top stage) to GND + 0.15 V (bottom stage)
- Large ±100 mA (max.) COM amp. driving current

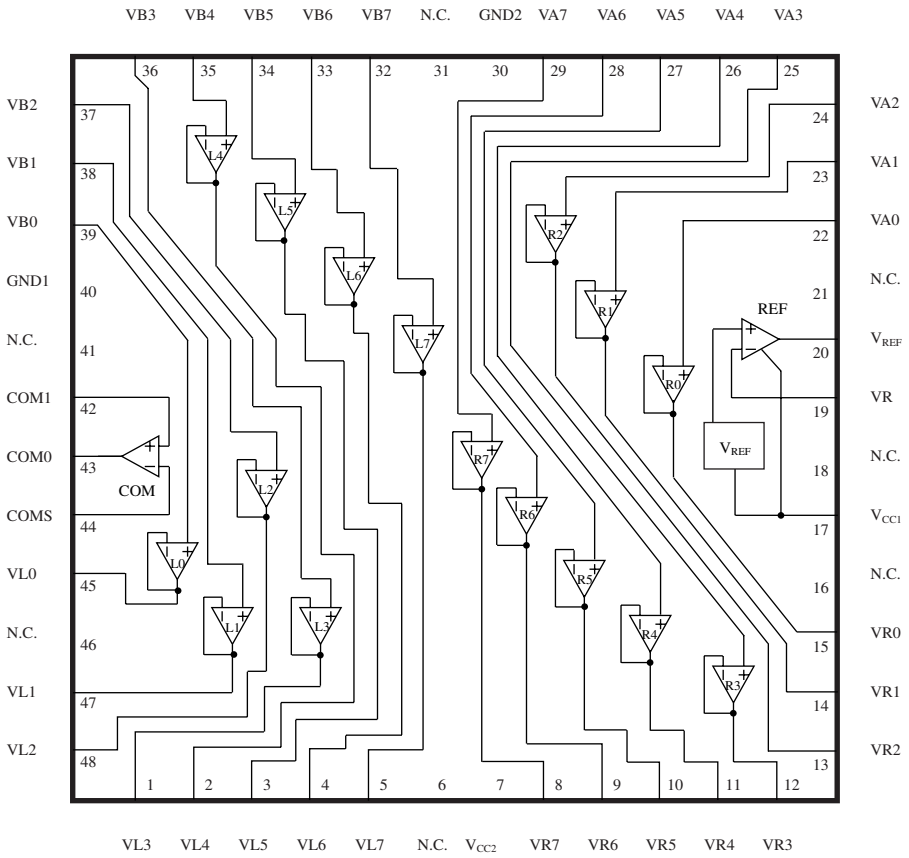
### ■ Applications

- Gray-scale power sources for LCDs




TQFP048-P-0707B (Lead-free package)

### ■ Block Diagram



## ■ Absolute Maximum Ratings

| Parameter | Symbol | Rating | Unit |
|---|---|---|---|
| Supply voltage | $V_{CC}$ | 15.8 | V |
| Supply current | $I_{CC}$ | — | mA |
| Power dissipation *2 | $P_D$ | 200 | mW |
| Operating ambient temperature *1 | $T_{opr}$ | 0 to +75 | °C |
| Strage temperature *1 | $T_{stg}$ | −55 to +125 | °C |
| REF amplifier output source current | $I_{O_{SOURCE}}$ | −5 | mA |
| R0 amplifier output source current | $I_{O_{-R0}}$ | −15 | mA |
| R0 amplifier output sink current | $I_{O_{+R0}}$ | 0.05 | mA |
| R0, R1, R2, R3, R4, R5, L5, L4, L3, L2, L1 amplifier output source current | $I_{O_{-R1\text{-}R5,\ L1\text{-}L5}}$ | −10 | mA |
| R6, R7, L7, L6 amplifier output source current | $I_{O_{-R6\text{-}L6}}$ | −15 | mA |
| R0, R1, R2, R3, R4, R5, L5, L4, L3, L2, L1 amplifier output sink current | $I_{O_{+R1\text{-}R5,\ L1\text{-}L5}}$ | 10 | mA |
| R6, R7, L7, L6 amplifier output sink current | $I_{O_{+R6\text{-}L6}}$ | 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 |
| REF amplifier maximum load capacitance | $C_{O_{REF}}$ | 0.2 | µF |
| R0, R1, R2, R3, R4, R5, R6, R7, L7, L6, L5, L4, L3, L2, L1, L0 amplifier maximum load capacitance | $C_{O_{R/L}}$ | 0.1 | µF |
| COM amplifier maximum load capacitance | $C_{O_{COM}}$ | 10 | µF |

Note) 1. Do not apply external currents or voltages to any pins not specifically mentioned.
For circuit currents, '+' denotes current flowing into the IC, and '−' denotes current flowing out of the IC.

2. *1: Except for the power dissipation, operating ambient temperature and storage temperature, all ratings are for $T_a$ = 25°C.
*2: $T_a$ = 75°C. For the independent IC without a heat sink.

## ■ Recommended Operating Range

| Parameter | | Symbol | Range | Unit |
|---|---|---|---|---|
| Supply voltage | | $V_{CC}$ | 7 to 15.5 | V |
| Load capacitance | R0 to L0 | CLOAD | 0.01 | µF |
| | COM | | 0.1 to 1 | µF |
| | REF | | 0.1 | µF |

■ Electrical Characteristics at $T_a$ = 25°C

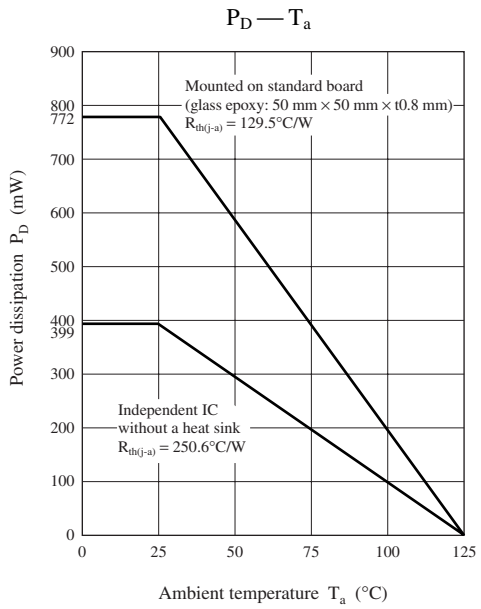
| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Circuit current | $I_{CC}$ | | — | — | 10 | mA |
| Reference voltage | $V_{REF}$ | | 1.19 | 1.23 | 1.27 | V |
| Input bias current | $I_B$ | | — | — | 500 | nA |
| REF amplifier block | | | | | | |
| Operating upper limit voltage | $V_H$ | $I_{OUT}$ = −2 mA, $C_{OUT}$ ≥ 0.1 µF | $V_{CC}$ − 0.2 | — | — | V |
| Operating lower limit voltage | VL | COUT ≥ 0.1 µF | — | — | $V_{REF}$ | V |
| R0 amplifier block | | | | | | |
| Output upper limit voltage 1 | $V_{H_{R01}}$ | $I_{OUT}$ = −10 mA | $V_{CC}$ − 0.2 | — | — | V |
| Output upper limit voltage 2 | $V_{H_{R02}}$ | $I_{OUT}$ = −15 mA | $V_{CC}$ − 0.23 | — | — | V |
| Output lower limit voltage | $V_{L_{R0}}$ | $I_{OUT}$ = 0.05 mA | — | — | $V_{CC}$ − 3.0 | V |
| Offset voltage | $V_{OFF_{R0}}$ | | — | — | 10 | mV |
| R1 amplifier block | | | | | | |
| Output upper limit voltage | $V_{H_{R1}}$ | $I_{OUT}$ = −10 mA | $V_{CC}$ − 0.3 | — | — | V |
| Output lower limit voltage | $V_{L_{R1}}$ | $I_{OUT}$ = 10 mA | — | — | $V_{CC}$ / 2 | V |
| Offset voltage | $V_{OFF_{R1}}$ | | — | — | 10 | mV |
| R2 amplifier block | | | | | | |
| Output upper limit voltage | $V_{HR2}$ | $I_{OUT}$ = −10 mA | $V_{CC}$ − 0.7 | — | — | V |
| Output lower limit voltage | $V_{L_{R2}}$ | $I_{OUT}$ = 10 mA | — | — | $V_{CC}$ / 2 | V |
| Offset voltage | $V_{OFF_{R2}}$ | | — | — | 10 | mV |
| R3, R4, R5, R6, R7, L3, L4, L5, L6, L7 amplifier block | | | | | | |
| Output upper limit voltage 1 | $V_{H_{R3\text{-}R5}}$ | $I_{OUT}$ = −10 mA | $V_{CC}$ − 1.2 | — | — | V |
| Output upper limit voltage 2 | $V_{H_{R6\text{-}R7}}$ | $I_{OUT}$ = −15 mA | $V_{CC}$ − 1.2 | — | — | V |
| Output lower limit voltage 1 | $V_{L_{R3\text{-}R5}}$ | $I_{OUT}$ = 10 mA | — | — | 2 | V |
| Output lower limit voltage 2 | $V_{L_{R6\text{-}R7}}$ | $I_{OUT}$ = 15 mA | — | — | 2 | V |
| Output upper limit voltage 3 | $V_{H_{L3\text{-}L5}}$ | $I_{OUT}$ = −10 mA | $V_{CC}$ − 2.0 | — | — | V |
| Output upper limit voltage 4 | $V_{H_{L6\text{-}L7}}$ | $I_{OUT}$ = −15 mA | $V_{CC}$ − 2.0 | — | — | V |
| Output lower limit voltage 3 | $V_{L_{L3\text{-}L5}}$ | $I_{OUT}$ = 10 mA | — | — | 1.2 | V |
| Output lower limit voltage 4 | $V_{L_{L6\text{-}L7}}$ | $I_{OUT}$ = 15 mA | — | — | 1.2 | V |
| Offset voltage | $V_{OFF_{34567}}$ | | — | — | 10 | mV |

■ Electrical Characteristics at $T_a$ = 25°C (continued)

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| L2 amplifier block | | | | | | |
| Output upper limit voltage | $V_{H_{L2}}$ | $I_{OUT}$ = −10 mA | $V_{CC}$ / 2 | — | — | V |
| Output lower limit voltage | $V_{L_{L2}}$ | $I_{OUT}$ = 10 mA | — | — | 0.7 | V |
| Offset voltage | $V_{OFF_{L2}}$ | | — | — | 10 | mV |
| L1 amplifier block | | | | | | |
| Output upper limit voltage | $V_{H_{L1}}$ | $I_{OUT}$ = −10 mA | $V_{CC}$ / 2 | — | — | V |
| Output lower limit voltage | $V_{L_{L1}}$ | $I_{OUT}$ = 10 mA | — | — | 0.25 | V |
| Offset voltage | $V_{OFF_{L1}}$ | | — | — | 10 | mV |
| L0 amplifier block | | | | | | |
| Output upper limit voltage | $V_{H_{L0}}$ | $I_{OUT}$ = − 0.05 mA | 3 | — | — | V |
| Output lower limit voltage | $V_{L_{L0}}$ | $I_{OUT}$ = 15 mA | — | — | 0.15 | V |
| Offset voltage | $V_{OFF_{L0}}$ | | — | — | 10 | mV |
| COM amplifier block | | | | | | |
| Output upper limit voltage | $V_{H_{COM}}$ | $I_{OUT}$ = −100 mA | $V_{CC}$ −2.5 | — | — | V |
| Output lower limit voltage | $V_{L_{COM}}$ | $I_{OUT}$ = 100 mA | — | — | 2.5 | V |
| Offset voltage | $V_{OFF_{COM}}$ | $V_{IN}$ = 5 V | — | — | 10 | mV |

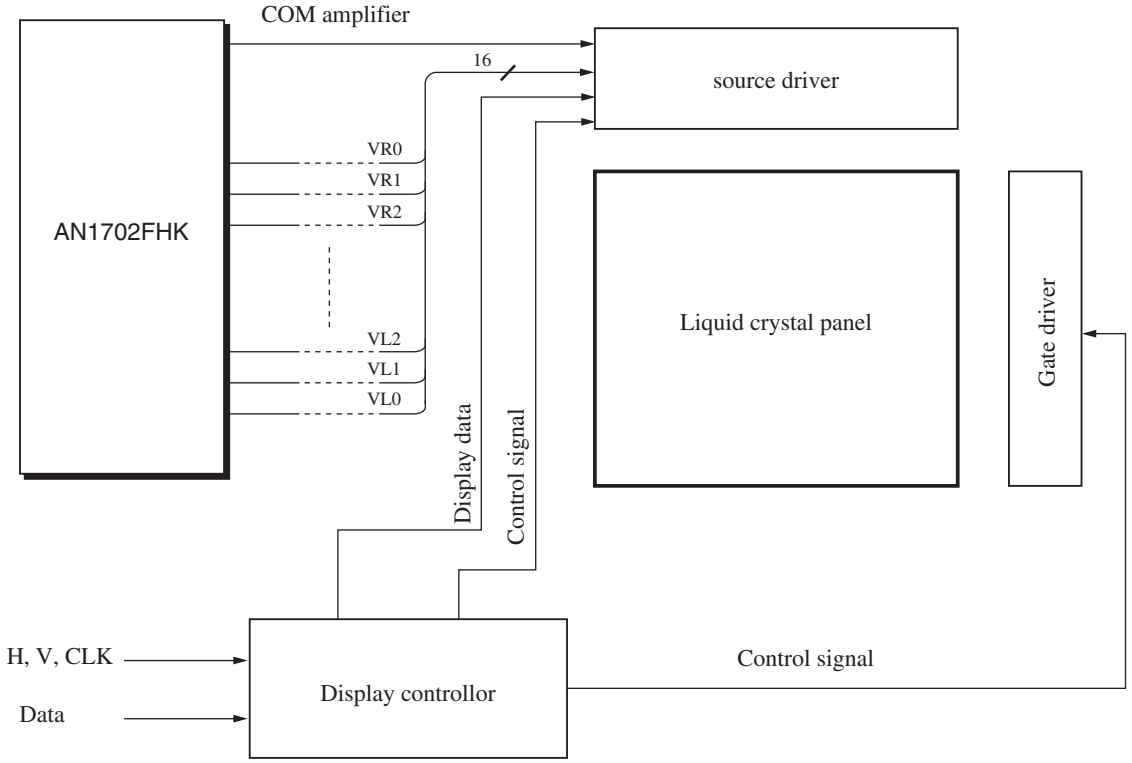
■ Technical Data

• $P_D$ — $T_a$ curves of TQFP048-P-0707B



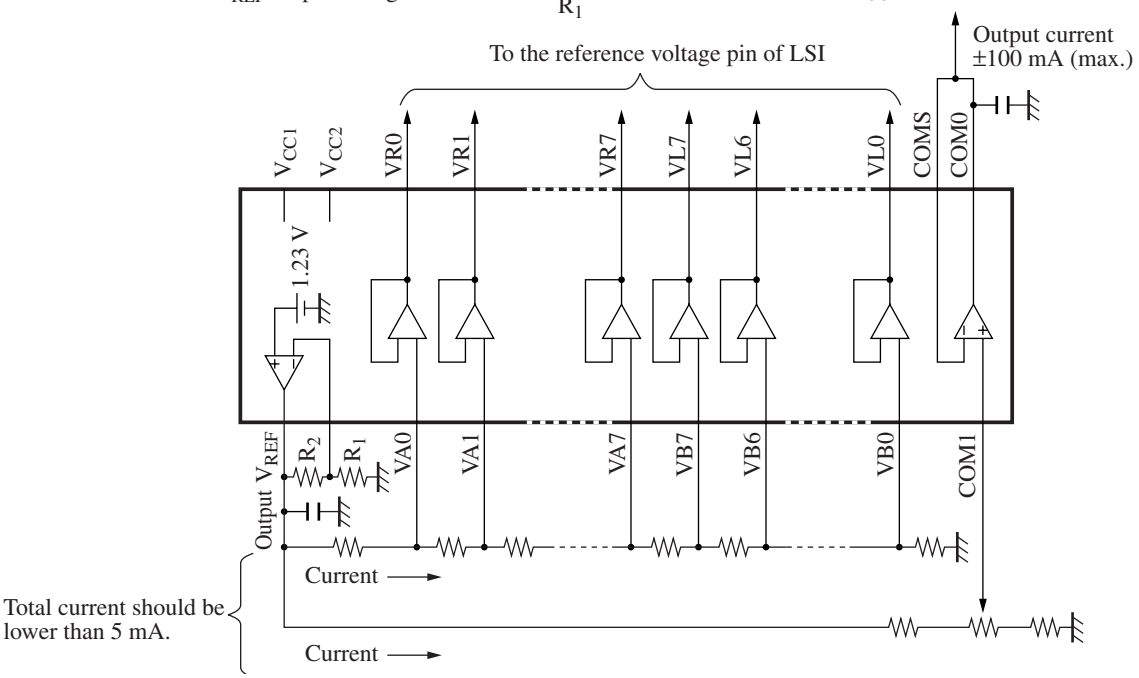
## ■ Application Circuit Example

• System configuration example




• Application circuit example

$$V_{REF}\ \text{output voltage} = 1.23\ V \times \frac{R_1 + R_2}{R_1}\ \text{(but this never exceeds } V_{CC})$$



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