

# 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 generator that supports 256 gradations, a reference voltage of 1.23 V, 16 output buffer amp circuits and a COM amplifier circuit.

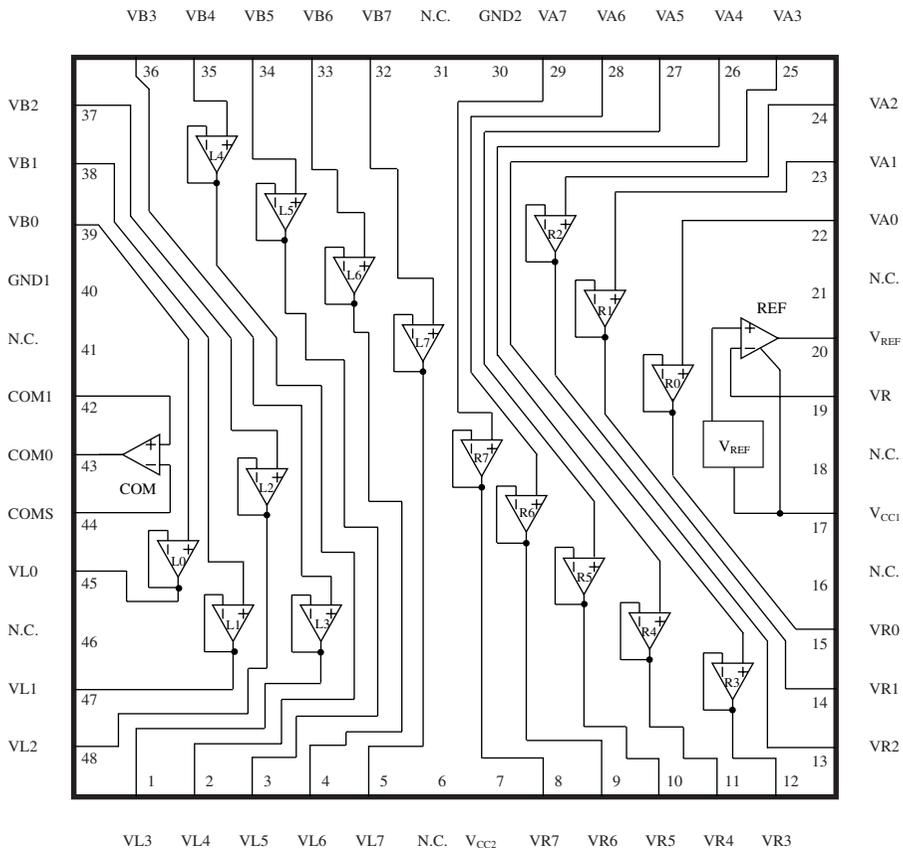
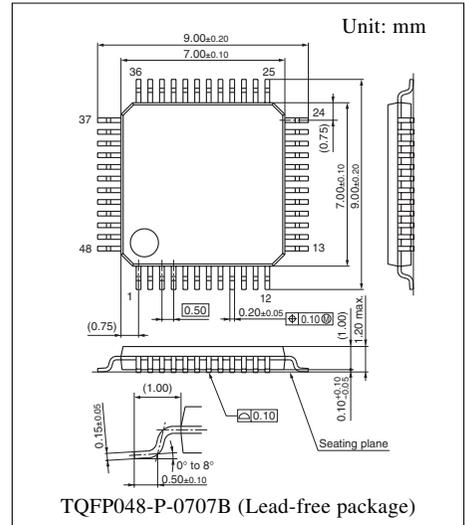
### ■ Features

- 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  $\pm 100$  mA (max.) COM amp. driving current

### ■ Applications

- Gray-scale power sources for LCDs

### ■ 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
Storage 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	$I_{O_{-R1-R5, L1-L5}}$	-10	mA
R6, R7, L7, L6 amplifier output source current	$I_{O_{-R6-L6}}$	-15	mA
R0, R1, R2, R3, R4, R5, L5, L4, L3, L2, L1 amplifier output sink current	$I_{O_{+R1-R5, L1-L5}}$	10	mA
R6, R7, L7, L6 amplifier output sink current	$I_{O_{+R6-L6}}$	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	$C_{OREF}$	0.2	μF
R0, R1, R2, R3, R4, R5, R6, R7, L7, L6, L5, L4, L3, L2, L1, L0 amplifier maximum load capacitance	$C_{ORL}$	0.1	μF
COM amplifier maximum load capacitance	$C_{OCOM}$	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  $T_a = 25^\circ\text{C}$ .

\*2:  $T_a = 75^\circ\text{C}$ . 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
	COM		0.1 to 1
	REF		0.1
			μF

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

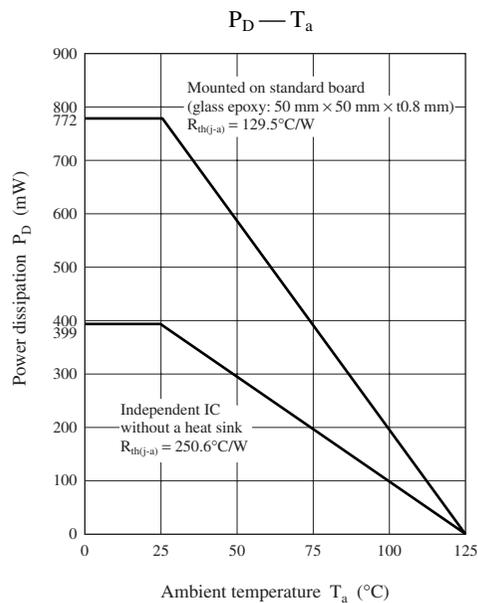
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Circuit current	$I_{CC}$		—	—	10	mA
Reference voltage	$V_{REF}$		1.19	1.23	1.27	V
Input bias current	$I_B$		—	—	500	nA
<b>REF amplifier block</b>						
Operating upper limit voltage	$V_H$	$I_{OUT} = -2 \text{ mA}, C_{OUT} \geq 0.1 \mu\text{F}$	$V_{CC} - 0.2$	—	—	V
Operating lower limit voltage	$V_L$	$C_{OUT} \geq 0.1 \mu\text{F}$	—	—	$V_{REF}$	V
<b>R0 amplifier block</b>						
Output upper limit voltage 1	$V_{HR01}$	$I_{OUT} = -10 \text{ mA}$	$V_{CC} - 0.2$	—	—	V
Output upper limit voltage 2	$V_{HR02}$	$I_{OUT} = -15 \text{ mA}$	$V_{CC} - 0.23$	—	—	V
Output lower limit voltage	$V_{LR0}$	$I_{OUT} = 0.05 \text{ mA}$	—	—	$V_{CC} - 3.0$	V
Offset voltage	$V_{OFFR0}$		—	—	10	mV
<b>R1 amplifier block</b>						
Output upper limit voltage	$V_{HR1}$	$I_{OUT} = -10 \text{ mA}$	$V_{CC} - 0.3$	—	—	V
Output lower limit voltage	$V_{LR1}$	$I_{OUT} = 10 \text{ mA}$	—	—	$V_{CC}/2$	V
Offset voltage	$V_{OFFR1}$		—	—	10	mV
<b>R2 amplifier block</b>						
Output upper limit voltage	$V_{HR2}$	$I_{OUT} = -10 \text{ mA}$	$V_{CC} - 0.7$	—	—	V
Output lower limit voltage	$V_{LR2}$	$I_{OUT} = 10 \text{ mA}$	—	—	$V_{CC}/2$	V
Offset voltage	$V_{OFFR2}$		—	—	10	mV
<b>R3, R4, R5, R6, R7, L3, L4, L5, L6, L7 amplifier block</b>						
Output upper limit voltage 1	$V_{HR3-R5}$	$I_{OUT} = -10 \text{ mA}$	$V_{CC} - 1.2$	—	—	V
Output upper limit voltage 2	$V_{HR6-R7}$	$I_{OUT} = -15 \text{ mA}$	$V_{CC} - 1.2$	—	—	V
Output lower limit voltage 1	$V_{LR3-R5}$	$I_{OUT} = 10 \text{ mA}$	—	—	2	V
Output lower limit voltage 2	$V_{LR6-R7}$	$I_{OUT} = 15 \text{ mA}$	—	—	2	V
Output upper limit voltage 3	$V_{HL3-L5}$	$I_{OUT} = -10 \text{ mA}$	$V_{CC} - 2.0$	—	—	V
Output upper limit voltage 4	$V_{HL6-L7}$	$I_{OUT} = -15 \text{ mA}$	$V_{CC} - 2.0$	—	—	V
Output lower limit voltage 3	$V_{LL3-L5}$	$I_{OUT} = 10 \text{ mA}$	—	—	1.2	V
Output lower limit voltage 4	$V_{LL6-L7}$	$I_{OUT} = 15 \text{ mA}$	—	—	1.2	V
Offset voltage	$V_{OFF34567}$		—	—	10	mV

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>L2 amplifier block</b>						
Output upper limit voltage	$V_{HL2}$	$I_{OUT} = -10\text{ mA}$	$V_{CC} / 2$	—	—	V
Output lower limit voltage	$V_{LL2}$	$I_{OUT} = 10\text{ mA}$	—	—	0.7	V
Offset voltage	$V_{OFFL2}$		—	—	10	mV
<b>L1 amplifier block</b>						
Output upper limit voltage	$V_{HL1}$	$I_{OUT} = -10\text{ mA}$	$V_{CC} / 2$	—	—	V
Output lower limit voltage	$V_{LL1}$	$I_{OUT} = 10\text{ mA}$	—	—	0.25	V
Offset voltage	$V_{OFFL1}$		—	—	10	mV
<b>L0 amplifier block</b>						
Output upper limit voltage	$V_{HL0}$	$I_{OUT} = -0.05\text{ mA}$	3	—	—	V
Output lower limit voltage	$V_{LL0}$	$I_{OUT} = 15\text{ mA}$	—	—	0.15	V
Offset voltage	$V_{OFFL0}$		—	—	10	mV
<b>COM amplifier block</b>						
Output upper limit voltage	$V_{HCOM}$	$I_{OUT} = -100\text{ mA}$	$V_{CC}$ -2.5	—	—	V
Output lower limit voltage	$V_{LCOM}$	$I_{OUT} = 100\text{ mA}$	—	—	2.5	V
Offset voltage	$V_{OFFCOM}$	$V_{IN} = 5\text{ V}$	—	—	10	mV

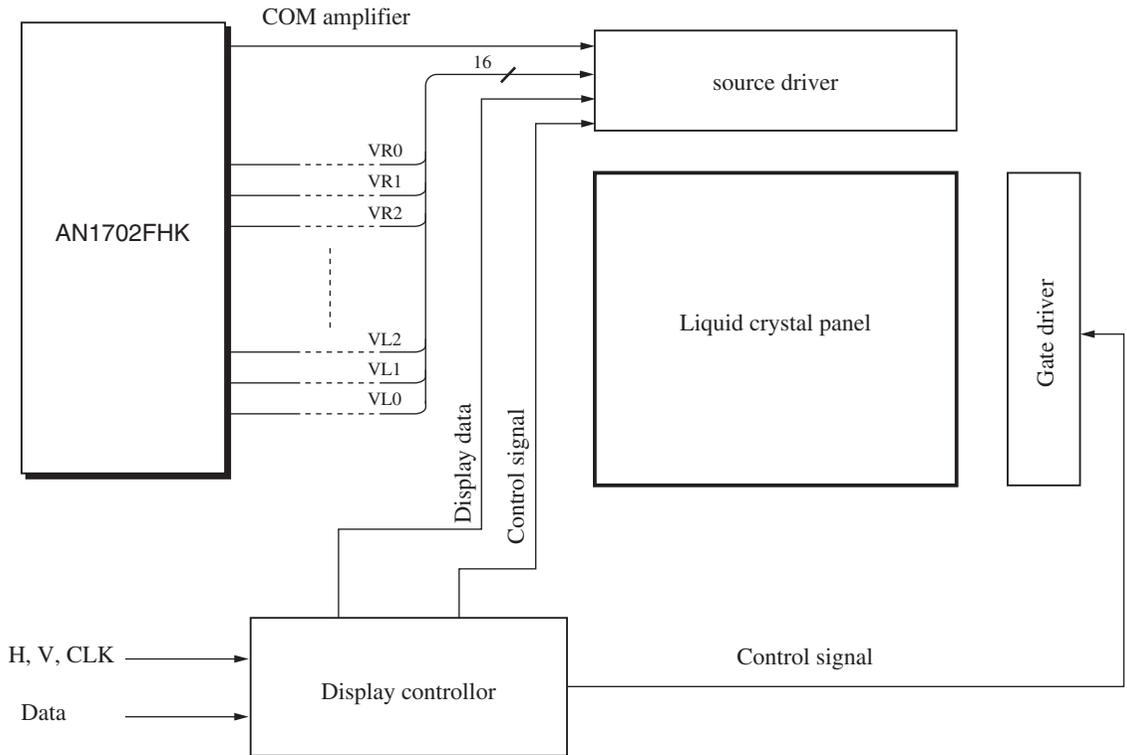
### ■ Technical Data

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



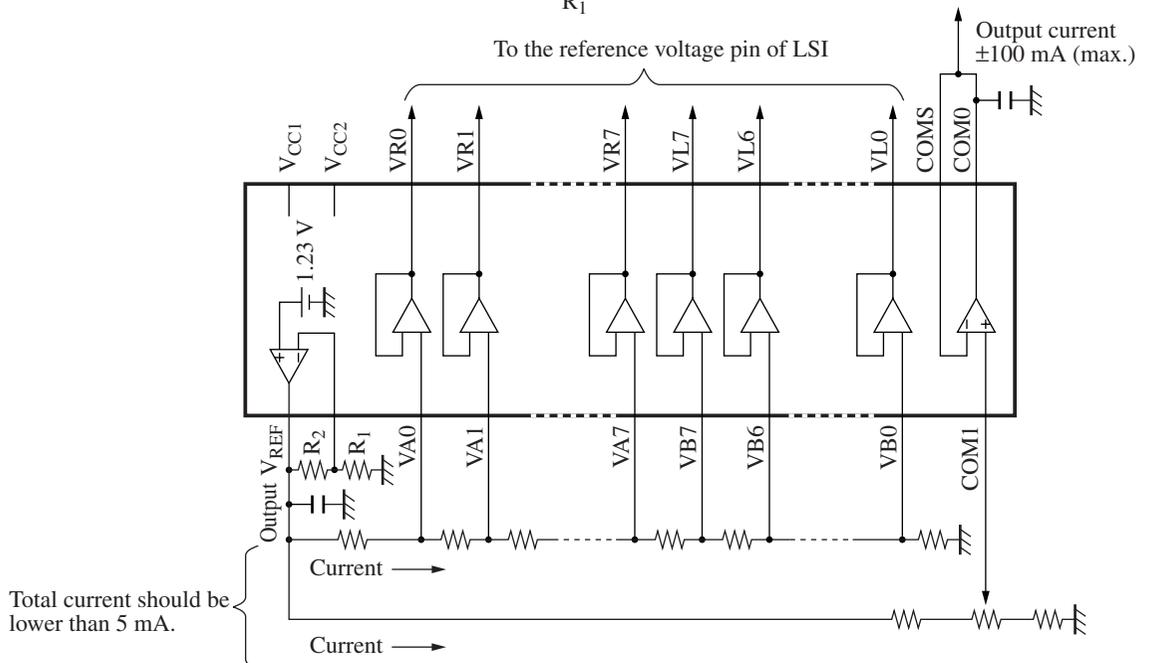
■ Application Circuit Example

- System configuration example



- Application circuit example

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



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