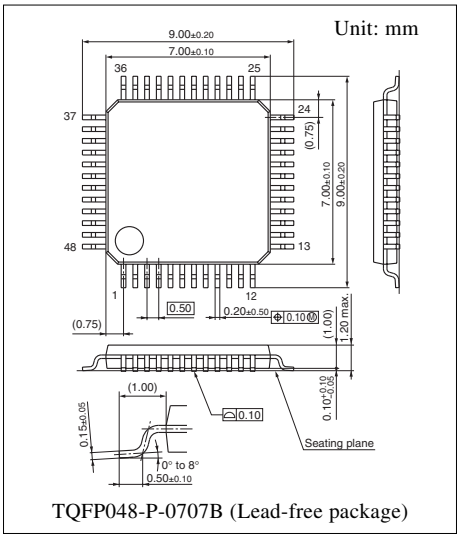
AN8001FHK

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.



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

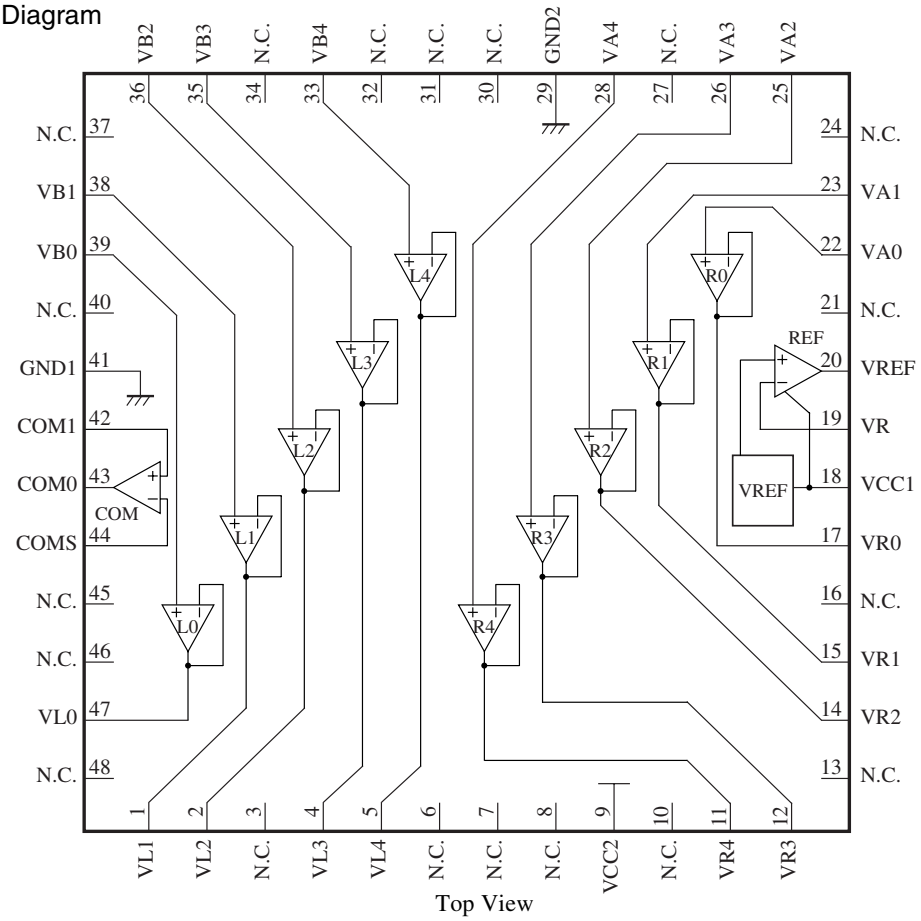
■ Features

- 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: ±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*2 220*3	mW
Operating ambient temperature*1	T_{opr}	0 to + 70	°C
Storage temperature*1	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°C, except for the operating ambient temperature and storage temperature parameters.

∗2 : T_a = 25°C

∗3 : T_a = 70°C

■ Recommended Operating Range

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

■ Electrical Characteristics at T_a = 25°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 Connect 0.1 µF or more for oscillation prevention	V_{CC} – 0.2 V	—	—	V
Operating upper limit voltage 2	V_{H2}	Discharge current : 3 mA Connect 0.1 µF or more for oscillation prevention	V_{CC} – 0.3 V	—	—	V
Operating lower limit voltage	V_L	Connect 0.1 µF or more for oscillation prevention	—	—	V_{REF}	V
R0 amplifier block						
Output upper limit voltage 1	$V_{H,R01}$	Discharge current : 10 mA	V_{CC} – 0.2 V	—	—	V
Output upper limit voltage 2	$V_{H,R02}$	Discharge current : 15 mA	V_{CC} – 0.25V	—	—	V
Output lower limit voltage	$V_{L,R0}$	Sink current : 0.1 mA	—	—	V_{CC} –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} – 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} –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} –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 µA	$V_{CC}/2$	—	—	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°C

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
L0 amplifier block						
Output upper limit voltage	$V_{H, L0}$	Discharge current : 50 µA	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} −2.5 V	—	—	V
Output lower limit voltage	$V_{L, COM}$	Sink current : 100 mA	—	—	2.5	V
Offset voltage	V_{OFFCOM}		—	—	10	mV

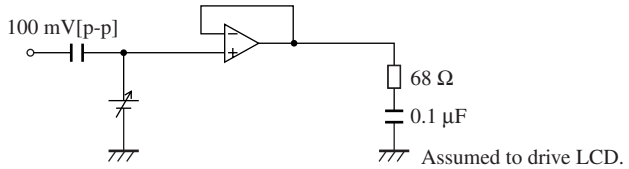
• Design reference data

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 COM		—	—	2	µS
REF amplifier block Supply voltage rejection ratio	$PSRR_{REF}$	f = 10 kHz to 500 kHz 200 mV[p-p], 0.1 µFconnection	—	—	−40	dB
R0 amplifier block Supply voltage rejection ratio	$PSRR_{R0}$	f = 10 kHz to 500 kHz 200 mV[p-p], 0.01 µFconnection	—	—	−10	dB
R1 amplifier block Supply voltage rejection ratio	$PSRR_{R1}$	f = 10 kHz to 500 kHz 200 mV[p-p], 0.01 µF connection	—	—	−20	dB
R2/R3R/4 amplifier block Supply voltage rejection ratio	$PSRR_{R234}$	f = 10 kHz to 500 kHz 200 mV[p-p], 0.01 µF connection	—	—	−40	dB
R2/R3R/4 amplifier block Supply voltage rejection ratio	$PSRR_{L234}$	f = 10 kHz to 500 kHz 200 mV[p-p], 0.01 µF connection	—	—	−40	dB
L1 amplifier block Supply voltage rejection ratio	$PSRR_{L1}$	f = 10 kHz to 500 kHz 200 mV[p-p], 0.01 µF connection	—	—	−10	dB
L0 amplifier block Supply voltage rejection ratio	$PSRR_{L0}$	f = 10 kHz to 500 kHz 200 mV[p-p], 0.01 µF connection	—	—	−20	dB
COM amplifier block Supply voltage rejection ratio	$PSRR_{COM}$	f = 10 kHz to 500 kHz 200 mV[p-p], 0.1 µF connection	—	—	−40	dB

■ Technical Data

• Mearsurement circuit for gain and phase characteristics

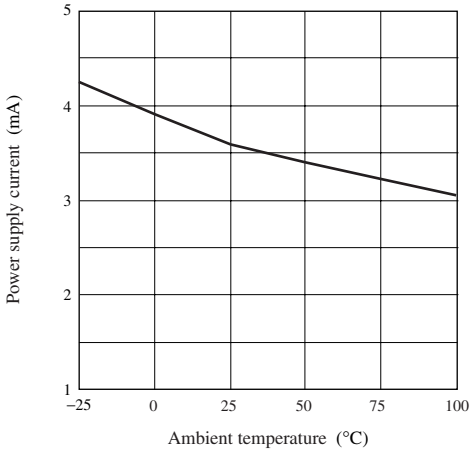


DC voltage

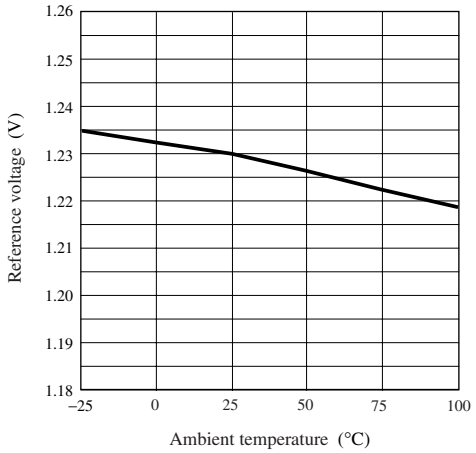
R0 DC = 9.7 V	L4 DC = 4.34 V
R1 DC = 9.01 V	L3 DC = 3.23 V
R2 DC = 7.81 V	L2 DC = 2.32 V
R3 DC = 7.12 V	L1 DC = 980 mV
R4 DC = 6.3 V	L0 DC = 210 mV

• Main characteristics

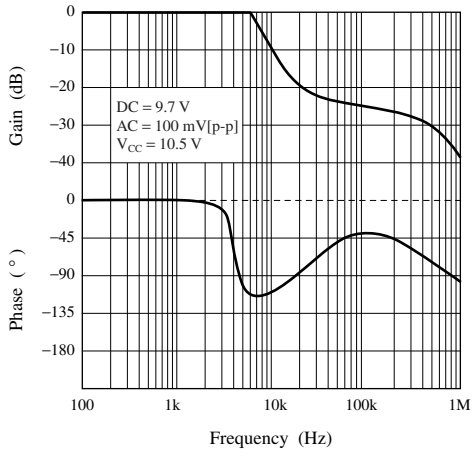
Power supply current — temperature characteristics (I_{CC} — T_a)



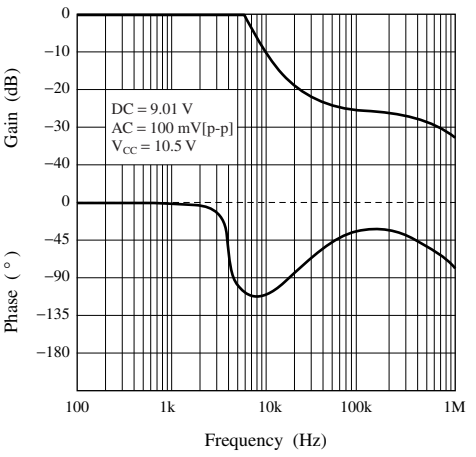
Reference voltage — temperature characteristics (V_{REF} — T_a)



R0 amp. Gain, Phase — Frequency



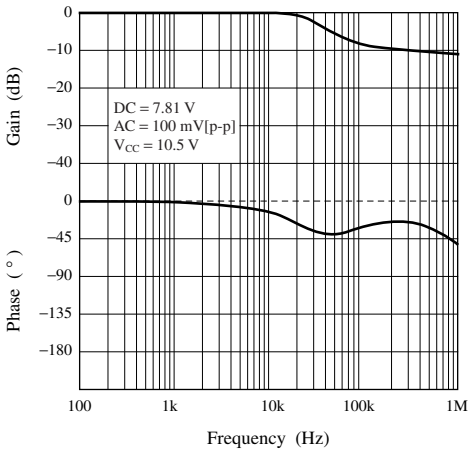
R1 amp. Gain, Phase — Frequency



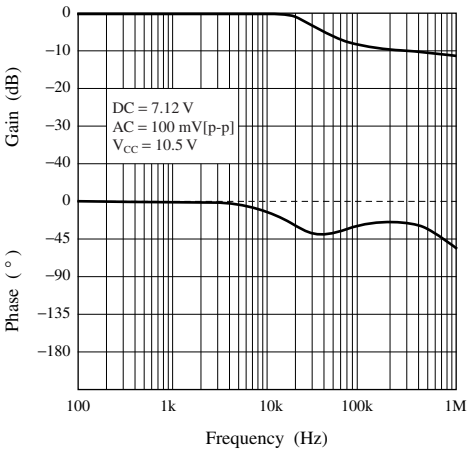
■ Technical Data (continued)

• Main characteristics (continued)

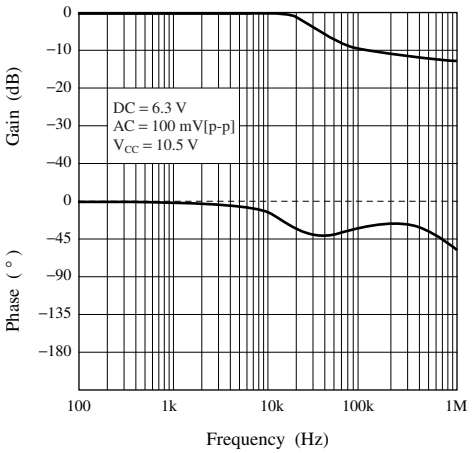
R2 amp. Gain, Phase — Frequency



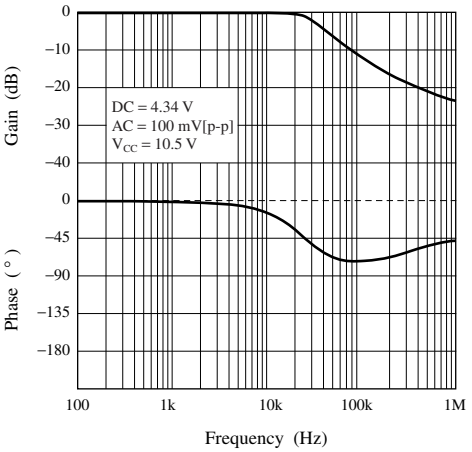
R3 amp. Gain, Phase — Frequency



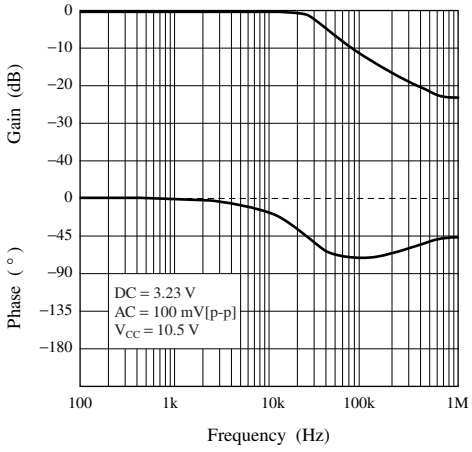
R4 amp. Gain, Phase — Frequency



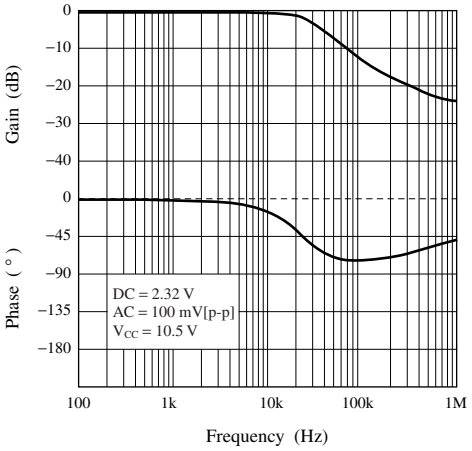
L4 amp. Gain, Phase — Frequency



L3 amp. Gain, Phase — Frequency



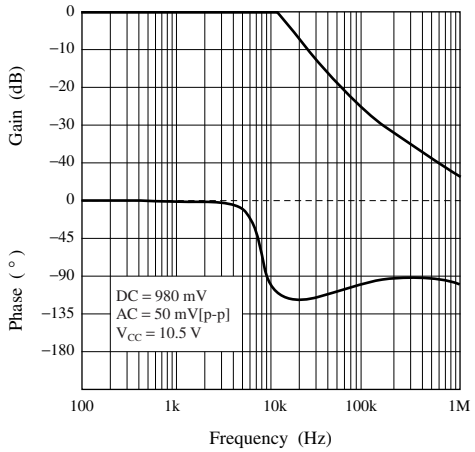
L2 amp. Gain, Phase — Frequency



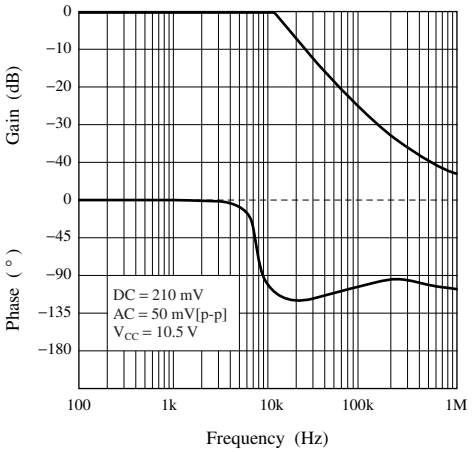
■ Technical Data (continued)

• Main characteristics (continued)

L1 amp. Gain, Phase — Frequency

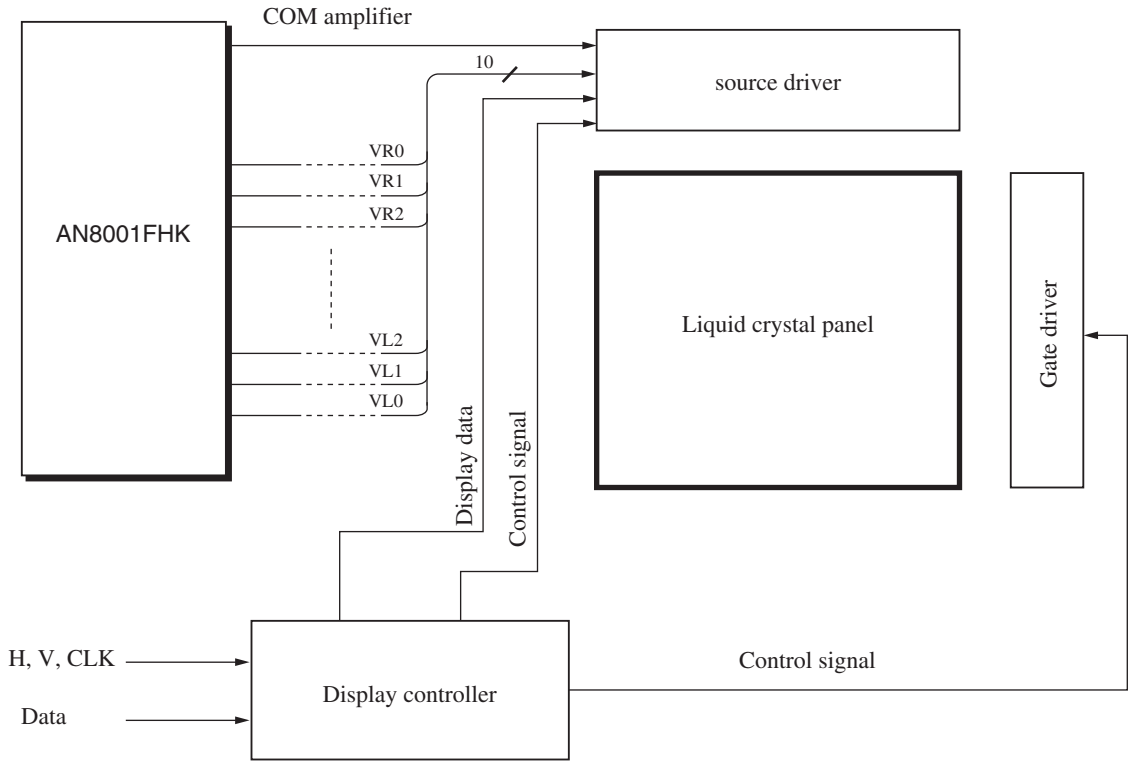


L0 amp. Gain, Phase — Frequency



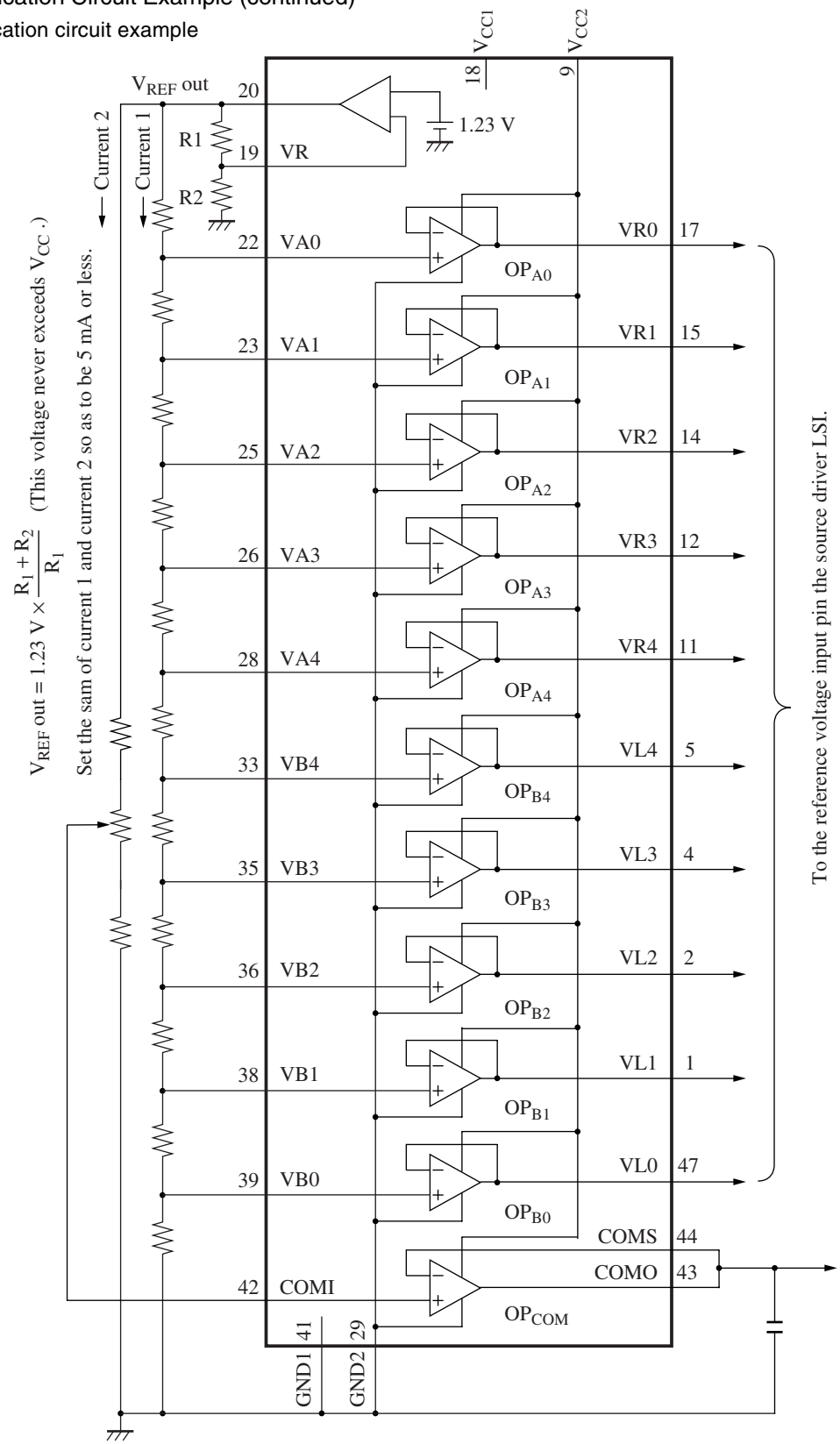
■ Application Circuit Example

• System configuration example



■ Application Circuit Example (continued)

• Application circuit example



■ Application Circuit Example (continued)

<Recommended operating conditions>

Parameter	Symbol	Ratings	Unit	Notes
Supply voltage	V_{CC}	10.5	V	
Load capacitance	C_{LOAD}	0.01	µF	VR0 to VL0
		0.1 to 1	µF	COM0
		0.1	µF	V_{REF}

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