

# Sense Current Amplifier

## Monolithic IC MM1380

### Outline

This IC improves on the previous sensor amp MM1089 (Dual). It is a single amp that allows current sensing regardless of the IC power supply ( $V_{CC}$ ). Further, the common mode signal rejection ratio and power supply fluctuation rejection ratio have been improved, and gain is switched between 50 and 100 times.

### Features

- |   |                        |
|---|------------------------|
| (1) Common mode signal rejection ratio (CMRR1.1kHz)       | 100dB typ.             |
| (2) Power supply fluctuation rejection ratio (PSRR1.1kHz) | 80dB typ.              |
| (3) Operating power supply voltage range                  | +3 ~ +24V              |
| (4) Consumption current                                   | 150 $\mu$ A typ.       |
| (5) Voltage gain  | 50/100 times switching |
| (6) Input equivalent offset voltage                       | $\pm$ 0.5mV            |
| (7) Current detection                                     | High/Low switching     |
| (8) Single type   |                        |

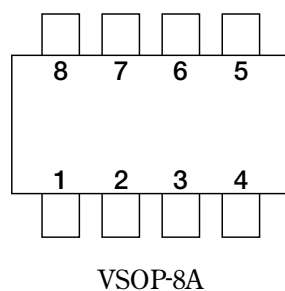
### Package

VSOP-8A

### Applications

- (1) Notebook PCs
- (2) PDA

### Pin Assignment

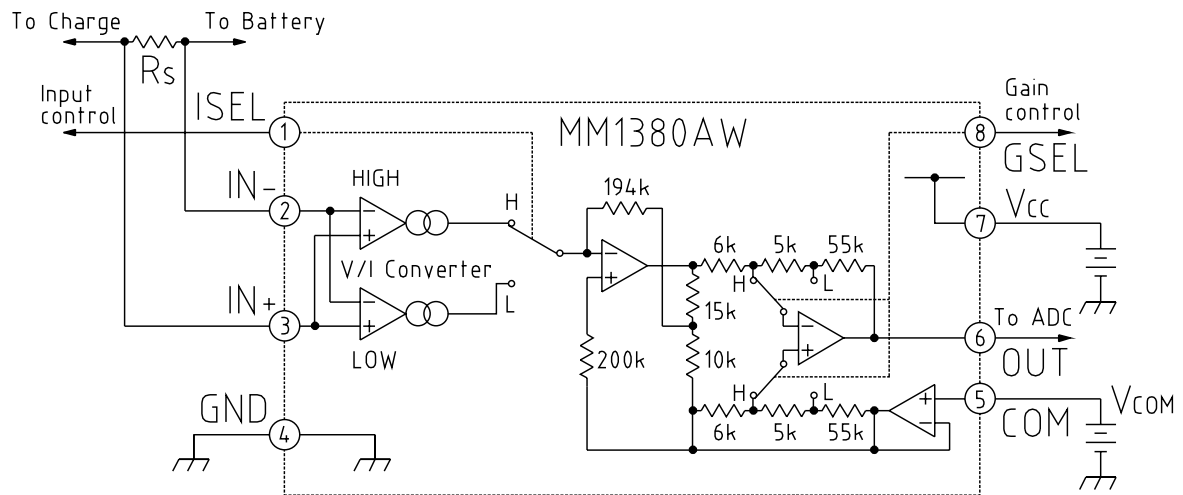


1	ISEL
2	IN-
3	IN+
4	GND
5	COM
6	OUT
7	$V_{CC}$
8	GSEL

Pin Description

Pin No.	Pin name	Functions	Internal equivalent circuit
1	ISEL	Input selection switch terminal Input common mode voltage range ISEL="H" : from 1.8V to 24V ISEL="L" : from -0.3V to V <sub>CC</sub> -2.4V	
4	GND	Ground terminal	
2	IN-	Inverted input terminal	
3	IN+	Non-Inverted input terminal	
5	COM	Reference voltage input terminal	
6	OUT	Output terminal	
7	V <sub>CC</sub>	Supply voltage terminal	
8	GSEL	Gain selection switch terminal Voltage gain GSEL="H" : G <sub>v</sub> =100 GSEL="L" : G <sub>v</sub> =50	

**Block Diagram**



**Absolute Maximum Ratings**

Item	Symbol	Ratings	Units
Storage temperature	T <sub>STG</sub>	-40~+125	°C
Supply voltage	V <sub>CCmax.</sub>	-0.3~+25	V
Input terminal voltage	V <sub>imax.</sub>	-0.3~+25	V
Allowable loss	P <sub>d</sub>	300	mW

**Recommended Operating Conditions**

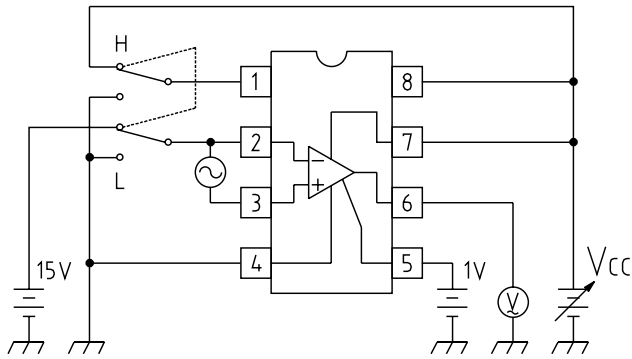
Item	Symbol	Ratings	Units
Operating temperature	T <sub>OPR</sub>	-20~+85	°C
Operating voltage	V <sub>CC</sub>	+3~+24	V

**Electrical Characteristics** (Except where otherwise indicated,  $T_a=25^\circ\text{C}$ ,  $V_{CC}=5\text{V}$ ,  $V_{ICM}=15\text{V}$ ,  $V_{COM}=25\text{V}$ ,  $V_{ISEL}=5\text{V}$ ,  $V_{GSEL}=5\text{V}$ ,  $R_L=10\text{k}\Omega$ )

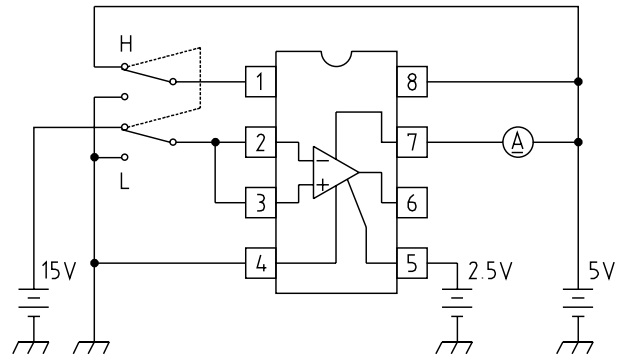
Item	Signal	Measurement conditions	Min.	Typ.	Max.	Unit
Supply voltage range	$V_{CC}$	$V_{COM}=V_{CC}/2$	3		24	V
Supply current	$I_{CC}$	$\Delta V_{IN}=0\text{V}$ , $R_L$ : OPEN		150	200	$\mu\text{A}$
Voltage gain 1 ( $\times 100$ )	$G_{V1}$	$V_{GSEL}=5\text{V}$	97	100	103	$\text{mV}/\text{mV}$
Voltage gain 2 ( $\times 50$ )	$G_{V2}$	$V_{GSEL}=0\text{V}$	48.5	50	51.5	$\text{mV}/\text{mV}$
Input offset voltage 1 (High side)	$V_{OFF1}$	$\Delta V_{IN}=0\text{V}$ , $V_{ISEL}=5\text{V}$	-0.5		0.5	mV
Input offset voltage 2 (Low side)	$V_{OFF2}$	$\Delta V_{IN}=0\text{V}$ , $V_{ISEL}=0\text{V}$	-0.5		0.5	mV
Temperature coefficient of Voff 1	$\Delta V_{OFF1}$	$V_{ISEL}=5\text{V}$	-4		4	$\mu\text{V}/^\circ\text{C}$
Temperature coefficient of Voff 2	$\Delta V_{OFF2}$	$V_{ISEL}=0\text{V}$	-6		6	$\mu\text{V}/^\circ\text{C}$
Input common mode voltage range 1 (High side)	$V_{ICM1}$	$V_{ISEL}=5\text{V}$	1.8		24	V
Input common mode voltage range 2 (Low side)	$V_{ICM2}$	$V_{ISEL}=0\text{V}$	-0.3		$V_{CC}-2.4$	V
Input differential voltage	$V_{IDF}$		-200		200	mV
Input bias current 1 (High side)	$I_{B1}$	$V_{ISEL}=5\text{V}$ , $\Delta V_{IN}=0\text{V}$	0.8	1.2	1.6	$\mu\text{A}$
Input bias current 2 (Low side)	$I_{B2}$	$V_{ISEL}=0\text{V}$ , $\Delta V_{IN}=0\text{V}$	-0.8	-1.2	-1.6	$\mu\text{A}$
Input impedance	$Z_i$		100			$\text{k}\Omega$
COM terminal voltage range	$V_{COM}$	$R_L$ : OPEN	1.2		$V_{CC}-1.2$	V
ISEL terminal current	$I_{ISEL}$	$V_{ISEL}=5\text{V}$		1.0		$\mu\text{A}$
ISEL terminal voltage range 1 (High side)	$V_{ISEL1}$		1.7		24	V
ISEL terminal voltage range 2 (Low side)	$V_{ISEL2}$		0		0.5	V
GSEL terminal sink current	$I_{GSEL}$	$V_{GSEL}=5\text{V}$		1.0		$\mu\text{A}$
GSEL terminal voltage range 1 ( $\times 100$ )	$V_{GSEL1}$		1.7		24	V
GSEL terminal voltage range 2 ( $\times 50$ )	$V_{GSEL2}$		0		0.5	V
Output voltage range	$V_{OUT}$	$R_L$ : OPEN	0.3		$V_{CC}-0.3$	V
Output source current	$I_{SRC}$	$V_{OUT}=V_{CC}-0.3\text{V}$	0.5	1.0		mA
Output sink current	$I_{SNK}$	$V_{OUT}=0.3\text{V}$	-0.5	-1.0		mA
Cut off frequency 1 ( $G_{V1}=100$ )	$F_{C1}$	$V_{GSEL}=5\text{V}$ , $V_{OUT}=-3\text{dB}$		100		kHz
Cut off frequency 2 ( $G_{V2}=50$ )	$F_{C2}$	$V_{GSEL}=0\text{V}$ , $V_{OUT}=-3\text{dB}$		140		kHz
Supply voltage rejection ratio 1 (High side)	PSRR1	$f=1\text{kHz}$ , $V_{ISEL}=5\text{V}$	70	80		dB
Supply voltage rejection ratio 2 (Low side)	PSRR2	$f=1\text{kHz}$ , $V_{ISEL}=0\text{V}$	70	80		dB
Common mode rejection ratio 1 (High side)	CMRR1	$f=1\text{kHz}$ , $V_{ISEL}=5\text{V}$	70	80		dB
Common mode rejection ratio 2 (Low side)	CMRR2	$f=1\text{kHz}$ , $V_{ISEL}=0\text{V}$	70	80		dB

Measuring Circuit

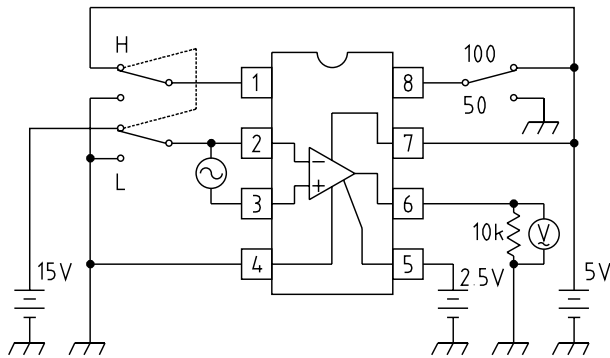
Supply voltage range



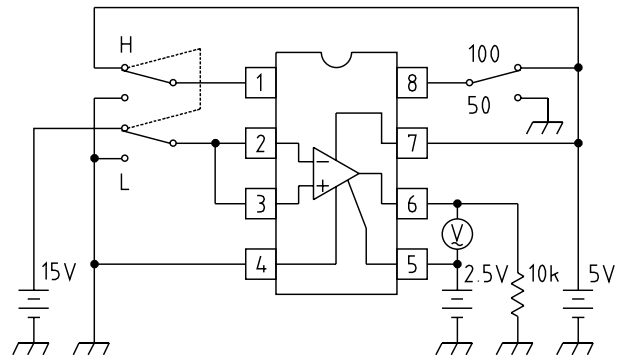
Supply current



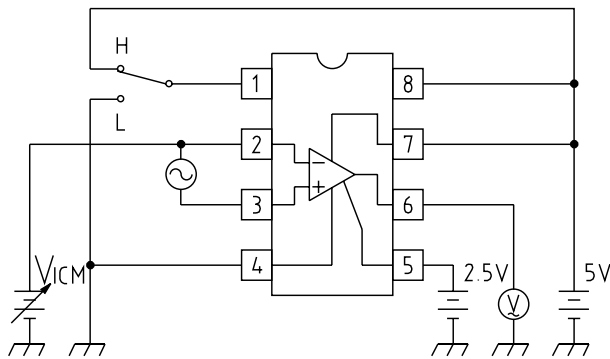
Voltage gain



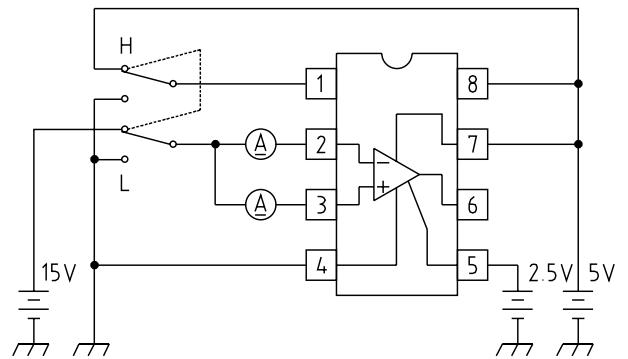
Offset voltage



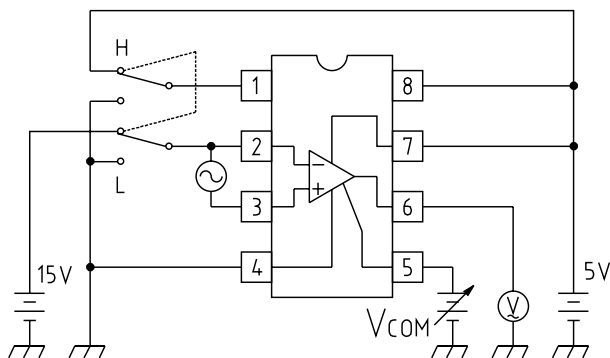
Input common mode voltage range



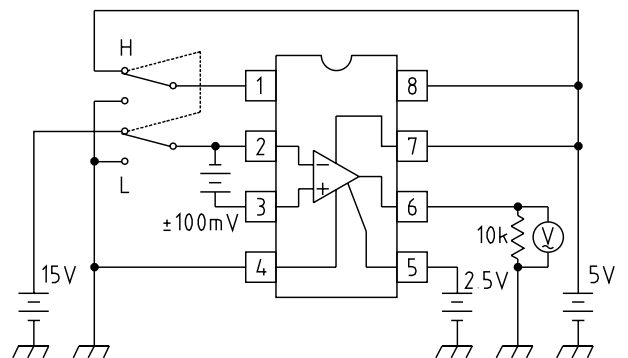
Input bias current



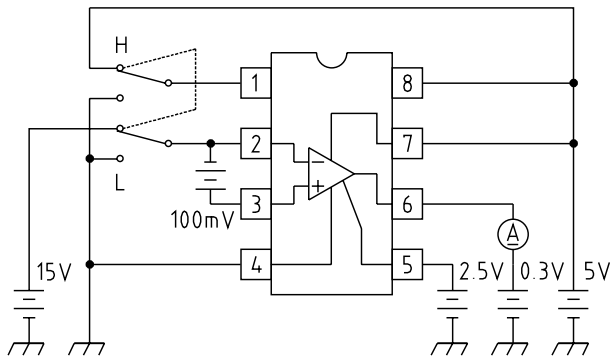
COM terminal voltage range



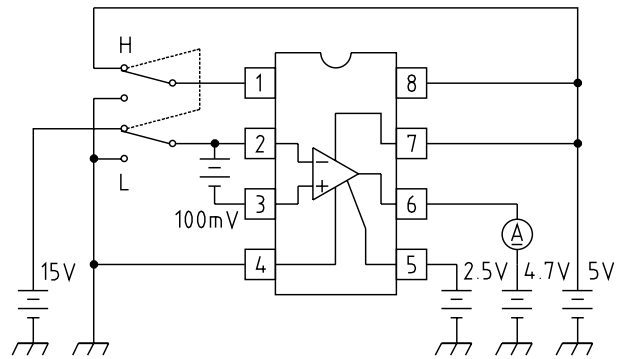
Output voltage range



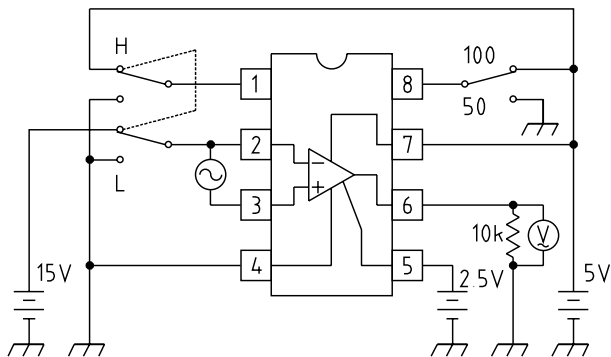
■ Output source current



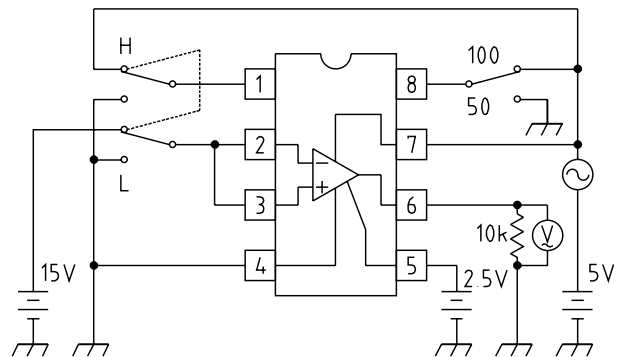
■ Output sink current



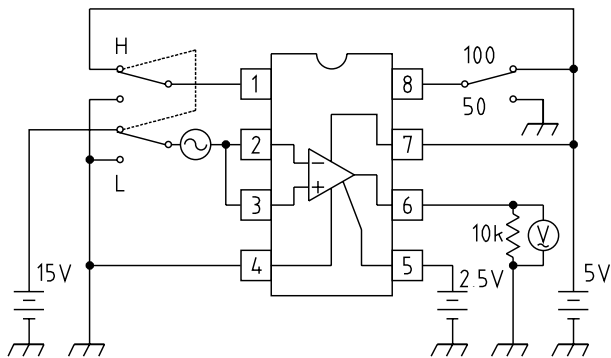
■ Cut off frequency



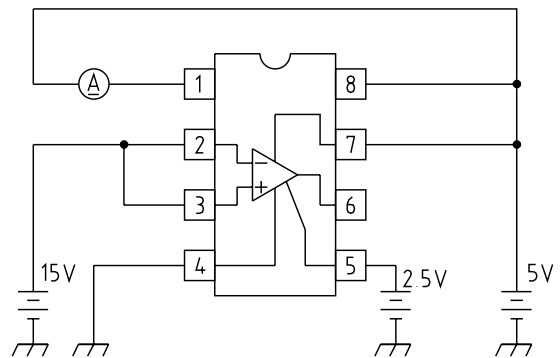
■ Supply voltage rejection ratio



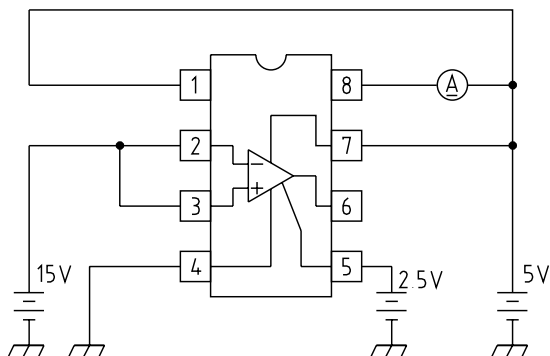
■ Common mode rejection ratio



■ ISEL terminal sink current

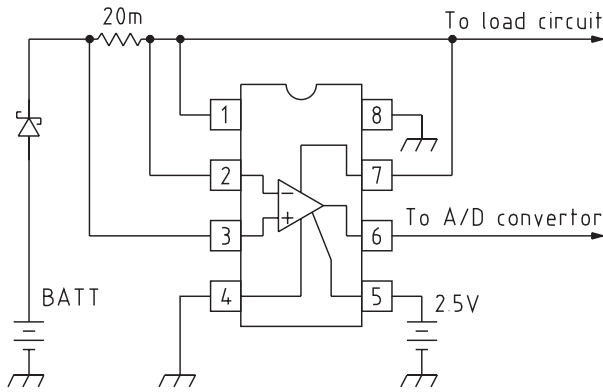


■ GSEL terminal sink current



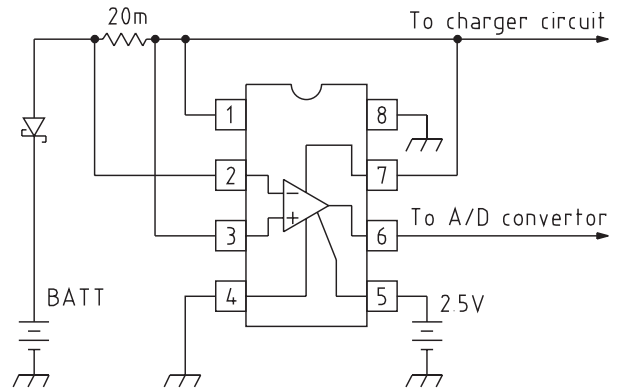
Application Circuit

Battery current sensing circuit



$R_s=20m\Omega$ 、 $G_v=50:1V/A$

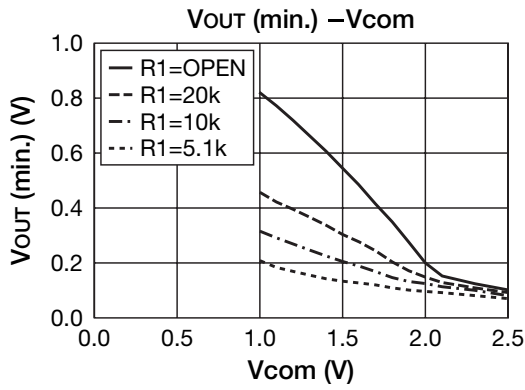
Charger current sensing circuit



$R_s=20m\Omega$ 、 $G_v=50:1V/A$

Characteristics

Minimum output voltage-COM terminal voltage



Input bias current-differential input voltage

