

## GENERAL DESCRIPTION

The HM6220 is an efficient linear voltage regulator with an ultralow-noise output, a very low dropout voltage (typically 17mV at light loads and 165mV at 150mA), and a very low ground current (600µA at 100mA output). The HM6220 offers better than 1% initial accuracy.

Designed especially for hand-held, battery-powered devices, the HM6220 includes a CMOS- or TTL-compatible enable/shutdown control input. When shut down, its power consumption drops nearly to zero. The regulator ground current increases only slightly in a dropout, further prolonging the battery life.

The HM6220 key features are a reference bypass (BYP) pin to improve its already excellent low-noise performance, reversed-battery protection, current limiting, and overtemperature shutdown.

The HM6220 is available in fixed (-XX) and adjustable (Adj) output voltage versions in a small SOT-23-5 package.

The fixed output voltage version - HM6220-XX - may have a nominal output voltage (XX) within 1.5V to 12V.

## FEATURES

- Ultralow-noise output
- High output voltage accuracy
- Guaranteed 150mA output
- Low quiescent current
- Low dropout voltage
- Extremely tight load and line regulation
- Very low temperature coefficient
- Current and thermal limiting
- Reverse-battery protection
- "Zero" off-mode current
- Logic-controlled electronic enable

## APPLICATIONS

- Cellular telephones
- Laptop, notebook, and palmtop computers
- Battery-powered equipment
- PCMCIA  $V_{CC}$  and  $V_{PP}$  regulation/switching
- Consumer/personal electronics
- SMPS post-regulator/dc-to-dc modules
- High-efficiency linear power supplies

## TYPICAL APPLICATION

### J O 8442-XX

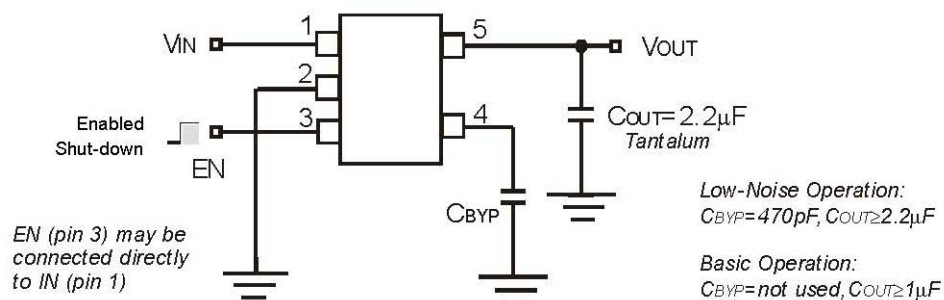


Fig.1. Ultralow-noise regulator

**PIN CONFIGURATION**

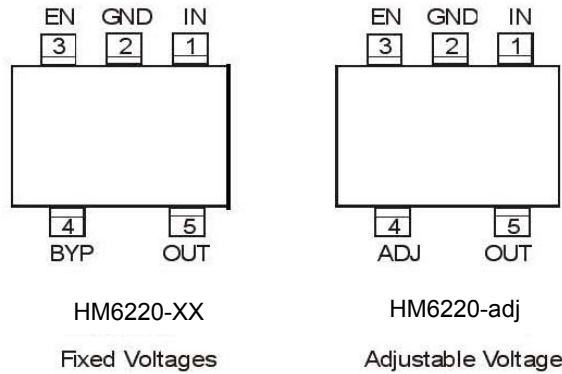


Fig.2

**PIN DESCRIPTION**

| Pin       |            | Name | Function  |
|-----------|------------|------|---|
| HM6220-XX | HM6220-adj |      |   |
| 1         | 1          | IN   | Supply input  |
| 2         | 2          | GND  | Ground  |
| 3         | 3          | EN   | Enable/Shutdown input: CMOS-compatible. Logic High = Enabled. Logic Low or Open = Shut-down.        |
| 4         |            | BYP  | Reference bypass: connect external 470pF capacitor to GND to reduce output noise. May be left open. |
|           | 4          | ADJ  | Adjust input: adjustable regulator feedback input. Connect to resistor voltage divider              |
| 5         | 5          | OUT  | Regulator output  |

**ABSOLUTE MAXIMUM RATINGS (Note 1)**

|  |                                  |
|--|----------------------------------|
| Supply input voltage ( $V_{IN}$ )      | .....-20V to +20V                |
| EN (enable) input voltage ( $V_{EN}$ ) | ..... -20V to +20V               |
| Power dissipation ( $P_D$ )            | .....Internally limited (Note 2) |
| Lead temperature (soldering, 5 sec.)   | .....260°C                       |
| Junction temperature ( $T_J$ )         | .....-40°C to +125°C             |
| Storage temperature ( $T_{STG}$ )      | .....-65°C to +150°C             |

**OPERATING RATINGS (Note 3)**

|  |                      |
|--|----------------------|
| Input voltage ( $V_{IN}$ )                     | .....+2.0V to +16V   |
| EN input voltage ( $V_{EN}$ )                  | .....0V to $V_{IN}$  |
| Junction temperature ( $T_J$ )                 | .....-40°C to +125°C |
| Thermal resistance, SOT-23-5 ( $\theta_{JA}$ ) | .....(Note 2)        |

## ELECTRICAL CHARACTERISTICS

(at  $V_{IN}=V_{OUT}+1V$ ,  $I_L=100\mu A$ ,  $C_L=1.0\mu F$ ,  $V_{EN}\geq 2.0V$ ,  $T_J=25^\circ C$ , unless specified otherwise; the **bold** values indicate  $-40^\circ C\leq T_J\leq +125^\circ C$ )

| Symbol                          | Parameters                             | Conditions  | Min      | Typ.  | Max                  | Units                  |
|---------------------------------|--|---|----------|-------|----------------------|------------------------|
| $V_{OUT}$<br>(Note 4)           | Output voltage accuracy                | Variation from specified $V_{OUT}$                              | -1<br>-2 |       | 1<br>2               | %<br>%                 |
| $\Delta V_{OUT}/\Delta T$       | Output voltage temperature coefficient | (Note 5)  |          | 40    |                      | ppm/ $^\circ C$        |
| $\Delta V_{OUT}/V_{OUT}/V_{IN}$ | Line regulation                        | $V_{IN}=V_{OUT}+1V$ to 16V                                      |          | 0.004 | 0.012<br><b>0.05</b> | %/V<br>%/V             |
| $\Delta V_{OUT}/V_{OUT}$        | Load regulation                        | $I_L=0.1mA$ to 150mA (Note 6)                                   |          | 0.02  | 0.2<br><b>0.5</b>    | %<br>%                 |
| $V_{IN}-V_{OUT}$                | Dropout voltage (Note 7)               | $I_L=100\mu A$  |          | 10    | 50<br><b>70</b>      | mV<br>mV               |
|                                 |  | $I_L=50mA$  |          | 110   | 150<br><b>230</b>    | mV<br>mV               |
|                                 |  | $I_L=100mA$   |          | 140   | 250<br><b>300</b>    | mV<br>mV               |
|                                 |  | $I_L=150mA$   |          | 165   | 275<br><b>350</b>    | mV<br>mV               |
| $I_{GND}$                       | Quiescent current                      | $V_{EN}\leq 0.4V$ (shut-down)<br>$V_{EN}\leq 0.18V$ (shut-down) |          | 0.01  | 1<br><b>5</b>        | $\mu A$<br>$\mu A$     |
| $I_{GND}$                       | GND pin current (Note 8)               | $V_{EN}\geq 2.0V$ , $I_L=100\mu A$                              |          | 120   | 160<br><b>180</b>    | $\mu A$<br>$\mu A$     |
|                                 |  | $I_L=50mA$  |          | 350   | 600<br><b>800</b>    | $\mu A$<br>$\mu A$     |
|                                 |  | $I_L=100mA$   |          | 600   | 1000<br><b>1500</b>  | $\mu A$<br>$\mu A$     |
|                                 |  | $I_L=150mA$   |          | 1300  | 1900<br><b>2500</b>  | $\mu A$<br>$\mu A$     |
| PSRR                            | Ripple Rejection                       | frequency=100Hz, $I_L=100\mu A$                                 |          | 75    |                      | dB                     |
| $I_{LIMIT}$                     | Current limit                          | $V_{OUT}=0V$  |          | 320   | 600                  | mA                     |
| $\Delta V_O/\Delta P_D$         | Thermal Regulation                     | (Note 9)  |          | 0.05  |                      | %/W                    |
| $E_{no}$                        | Output Noise                           | $I_L=50mA$ , $C_L=2.2\mu F$ , 470pF from BYP to GND             |          | 260   |                      | $\frac{nV}{\sqrt{Hz}}$ |

### Enable input

|          |                             |                     |            |      |                    |         |
|----------|-----------------------------|---------------------|------------|------|--------------------|---------|
| $V_{IL}$ | EN input logic Low voltage  | Regulator shut-down |            |      | 0.4<br><b>0.18</b> | V<br>V  |
|          |                             |                     |            |      |                    |         |
| $V_{IH}$ | EN input logic High voltage | Regulator enabled   | <b>2.0</b> |      |                    | V       |
| $I_{IL}$ | EN input current            | $V_{IL}\leq 0.4V$   |            | 0.01 | 1                  | $\mu A$ |
|          |                             | $V_{IL}\leq 0.18V$  |            |      | <b>2</b>           | $\mu A$ |
| $I_{IH}$ |                             | $V_{IH}\geq 2.0V$   | 2          | 5    | 35                 | $\mu A$ |
|          |                             | $V_{IH}\geq 2.0V$   |            |      | <b>40</b>          | $\mu A$ |

Note 1: Exceeding the absolute maximum rating may damage the device.

Note 2: The maximum allowable power dissipation at any  $T_A$  (ambient temperature) is  $P_{D(max)} = (T_{J(max)} - T_A) + \theta_{JA}$ . Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown. The HM6220 (all versions)  $\theta_{JA}$  value is 220 $^\circ C/W$  (the chip is mounted on a PC board).

Note 3: The device is not guaranteed to function outside its operating rating.

Note 4: HM6220-adj has  $V_{REF}=1.242\pm 1\%$ , but the minimum output voltage for HM6220-adj must be above  $V_{OUT(min)} = 1.5V$

Note 5: The **Output voltage temperature coefficient** is defined as the worst case voltage change divided by the total temperature range.

Note 6: The **Load regulation** is measured at a constant junction temperature using low duty cycle pulse testing. The parts per this parameter are tested in the load range of 0.1mA to 150mA.

Note 7: The **Dropout voltage** is defined as the input-to-output differential, at which the output voltage drops 2% below its nominal value measured at 1V differential. At very low values of programmed output voltage, the minimum input supply voltage of 2V must be taken into account.

Note 8: The **GND pin current** is the regulator Quiescent current plus the pass transistor base current. The total current drawn from the supply is the sum of the load current plus the GND pin current.

**Note 9.** Thermal regulation is defined as the change in output voltage at a time “t” after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a 150mA load pulse at  $V_{IN} = 16V$  for  $t = 10ms$ .

BLOCK DIAGRAMS

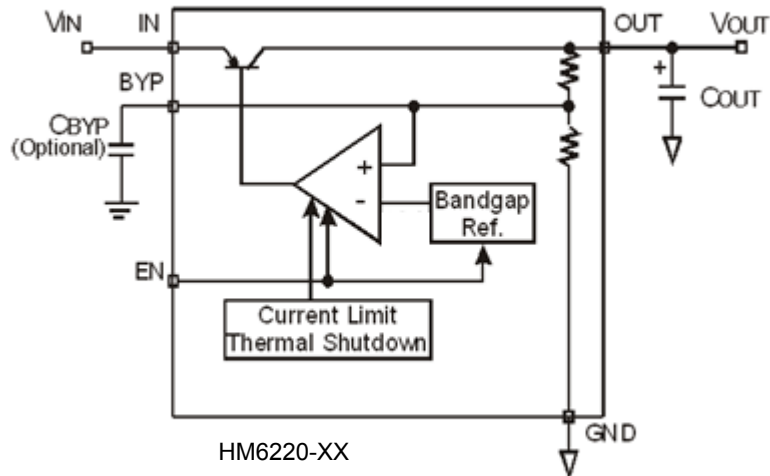


Fig.3a. Ultralow-noise fixed regulator

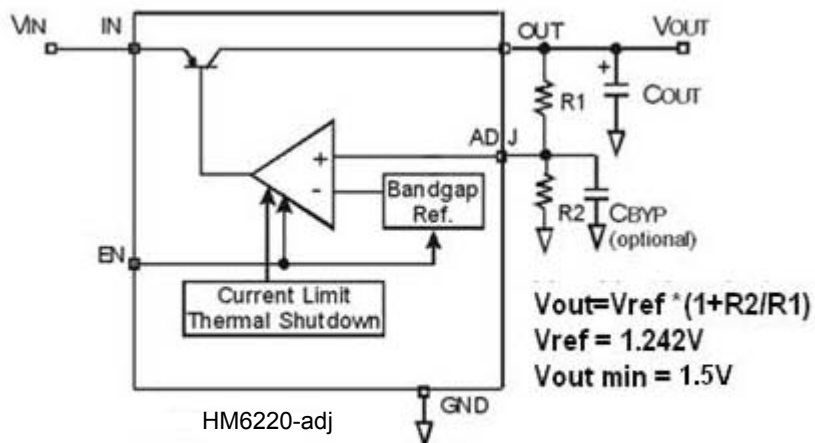
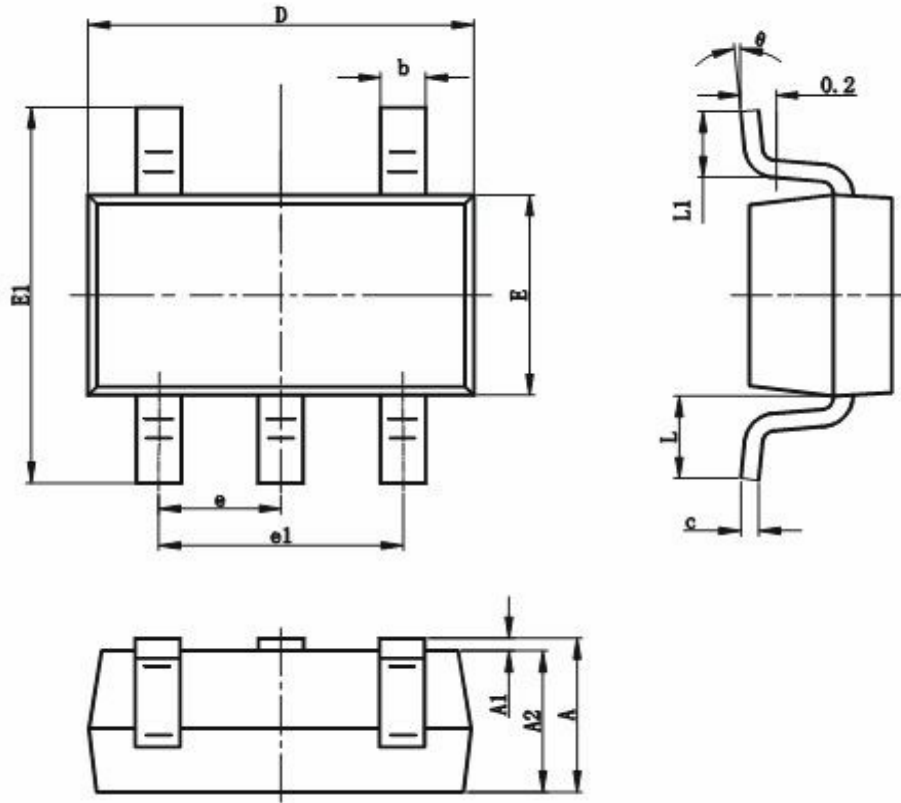


Fig.3b. Ultralow-noise adjustable regulator

SOT-23-5L PACKAGE OUTLINE DIMENSIONS



| Symbol | Dimensions In Millimeter |       | Dimensions In Inches |       |
|--------|--------------------------|-------|----------------------|-------|
|        | Min                      | Max   | Min                  | Max   |
| A      | 1.050                    | 1.250 | 0.041                | 0.049 |
| A1     | 0.000                    | 0.100 | 0.000                | 0.004 |
| A2     | 1.050                    | 1.150 | 0.041                | 0.045 |
| b      | 0.300                    | 0.400 | 0.012                | 0.016 |
| c      | 0.100                    | 0.200 | 0.004                | 0.008 |
| D      | 2.820                    | 3.020 | 0.111                | 0.119 |
| E      | 1.500                    | 1.700 | 0.059                | 0.067 |
| E1     | 2.650                    | 2.950 | 0.104                | 0.116 |
| e      | 0.950TYP                 |       | 0.037TYP             |       |
| e1     | 1.800                    | 2.000 | 0.071                | 0.079 |
| L      | 0.700REF                 |       | 0.028REF             |       |
| L1     | 0.300                    | 0.600 | 0.012                | 0.024 |
| ?      | 0                        | 8     | 0                    | 8     |