

## High Efficiency Linear Power Supply with Power Surveillance and Time-out

### Features

- Supply voltage monitoring
- Highly accurate 5 V, 100 mA guaranteed output
- Low dropout voltage, typically 380 mV at 100 mA
- Low quiescent current, typically 100  $\mu$ A
- Standby mode, maximum current 310  $\mu$ A (with 100  $\mu$ A load on OUTPUT)
- Unregulated DC input can withstand  $-20$  V reverse battery and  $+60$  V power transients
- Fully operational for unregulated DC input voltage up to 26 V and regulated output voltage down to 1 V
- Reset output guaranteed for regulated output voltage down to 1 V
- No reverse output current
- Very low temperature coefficient for the regulated output
- Current limiting
- Clear microprocessor restart after power up
- Push-pull or Open drain output
- $-40$  to  $+85^{\circ}\text{C}$  temperature range
- On request extended temperature range,  $-40$  to  $+125^{\circ}\text{C}$
- DIP8 and SO8 packages

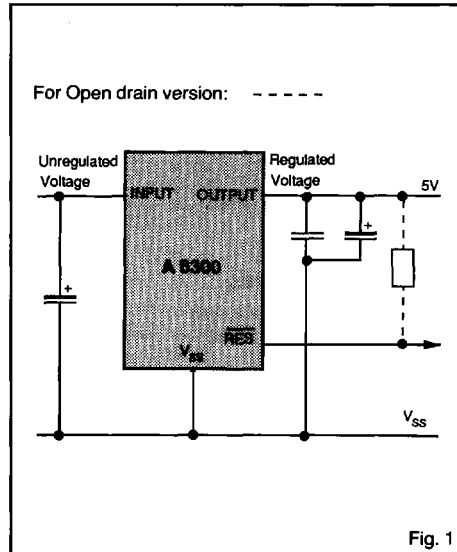
### Description

The A 6300 offers a high level of integration by combining voltage regulation and voltage monitoring. The voltage regulator has a low dropout voltage (typ. 380 mV at 100 mA) and a low quiescent current (100  $\mu$ A). The quiescent current increases only slightly in dropout prolonging battery life. Built-in protection includes a positive transient absorber for up to 60 V (load dump) and the ability to survive an unregulated input voltage of  $-20$  V (reverse battery). The INPUT may be connected to ground or a reverse voltage without reverse current flow from the OUTPUT to the INPUT. Upon the OUTPUT voltage rising above  $V_{TH}$ , the reset output, whether RES or RES, will remain active (RES = 1, RES = 0) for an additional time of 50 ms. This allows the system voltage and the oscillator of the microprocessor to stabilize before they become fully active. When  $V_{OUTPUT}$  falls below  $V_{TH}$ , the reset output goes active. Threshold voltage can be obtained in different versions: 2 V, 2.4 V, 2.8 V, 3.5 V, 4 V.

### Applications

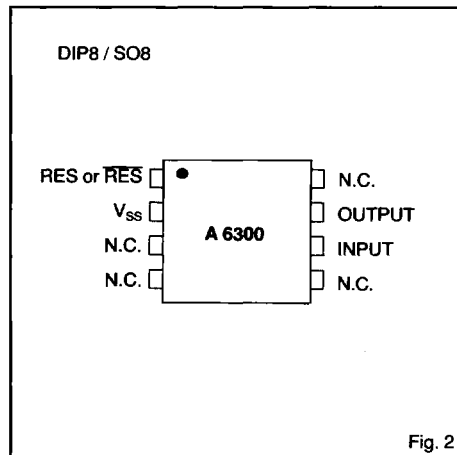
- White / brown goods
- Industrial electronics
- Automotive electronics
- Cellular telephones
- Security systems
- Battery powered products
- High efficiency linear power supplies

### Typical Operating Configuration



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### Pin Assignment





## Absolute Maximum Ratings

Parameter	Symbol	Conditions
Continuous voltage at INPUT to $V_{SS}$	$V_{INPUT}$	-0.3 to +30 V
Transients on INPUT for $t < 100$ ms and duty cycle 1%	$V_{TRANS}$	up to +60 V
Reverse supply voltage on INPUT	$V_{REV}$	-20 V
Max. voltage at any signal pin	$V_{MAX}$	OUTPUT+0.3V
Min. voltage at any signal pin	$V_{MIN}$	$V_{SS} - 0.3V$
Storage temperature	$T_{STO}$	-65 to +150°C
Electrostatic discharge max. to MIL-STD-883C method 3015	$V_{Smax}$	1000V
Max. soldering conditions	$T_{Smax}$	250°C x 10 s

Table 1

Stresses above these listed maximum ratings may cause permanent damage to the device. Exposure beyond specified operating conditions may affect device reliability or cause malfunction.

## Handling Procedures

This device has built-in protection against high static voltages or electric fields; however, anti-static precautions must be taken as for any other CMOS component. Unless otherwise specified, proper operation can only occur when all terminal voltages are kept within the supply voltage range. Unused inputs must always be tied to a defined logic voltage level.

## Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Units
Operating junction temperature <sup>1)</sup>	$T_J$	-40		+125	°C
INPUT voltage <sup>2)</sup>	$V_{INPUT}$	2.3		26	V
OUTPUT voltage <sup>2)3)</sup>	$V_{OUTPUT}$	1.0			V
Reset output guaranteed	$V_{OUTPUT}$	1.0			V
OUTPUT current <sup>4)</sup>	$I_{OUTPUT}$			100	mA
Thermal resistance from junction to ambient <sup>5)</sup>					
- DIP8	$R_{\theta(J-A)}$			105	°C/W
- SO8	$R_{\theta(J-A)}$			160	°C/W

Table 2

- 1) The maximum operating temperature is confirmed by sampling at initial device qualification. In production, all devices are tested at +85°C. On request devices tested at +125°C can be supplied.
- 2) Full operation guaranteed. To achieve the load regulation specified in Table 3 a 22  $\mu$ F capacitor or greater is required on the INPUT, see Fig. 6. The 22  $\mu$ F must have an effective resistance  $\leq 5 \Omega$  and a resonant frequency above 500 kHz.
- 3) A 10  $\mu$ F load capacitor and a 100 nF decoupling capacitor are required on the regulator OUTPUT for stability. The 10  $\mu$ F must have an effective series resistance of  $\leq 5 \Omega$  and a resonant frequency above 500 kHz.
- 4) The OUTPUT current will not apply for all possible combinations of input voltage and output current. Combinations that would require the A 6300 to work above the maximum junction temperature (+125°C) must be avoided.
- 5) The thermal resistance specified assumes the package is soldered to a PCB.



## Electrical Characteristics

$V_{INPUT} = 6.0\text{ V}$ ,  $C_L = 10\ \mu\text{F} + 100\ \text{nF}$ ,  $C_{INPUT} = 22\ \mu\text{F}$ ,  $T_J = -40\text{ to }+85^\circ\text{C}$ , unless otherwise specified

Parameter	Symbol	Test Conditions	Min.	Min. 25°C	Typ.	Max. 25°C	Max.	Unit
Supply current	$I_{SS}$	Reset output open, $I_L = 100\ \mu\text{A}$			100		310	$\mu\text{A}$
Supply current <sup>1)</sup>	$I_{SS}$	Reset output open, $I_L = 100\ \text{mA}$ at $V_{INPUT} = 8.0\ \text{V}$			1.7		4.2	$\text{mA}$
Output voltage	$V_{OUTPUT}$	$I_L = 100\ \mu\text{A}$	4.88				5.12	$\text{V}$
Output voltage	$V_{OUTPUT}$	$100\ \mu\text{A} \leq I_L \leq 100\ \text{mA}$ , $-40^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$	4.85				5.15	$\text{V}$
Output voltage temperature coefficient <sup>2)</sup>	$V_{th(\text{coeff})}$				50		180	$\text{ppm}/^\circ\text{C}$
Line regulation <sup>3)</sup>	$V_{Line}$	$6\ \text{V} \leq V_{INPUT} \leq 26\ \text{V}$ , $I_L = 1\ \text{mA}$ , $T_J = +125^\circ\text{C}$			0.2		0.5	%
Load regulation <sup>3)</sup>	$V_L$	$100\ \mu\text{A} \leq I_L \leq 100\ \text{mA}$			0.2		0.6	%
Dropout voltage <sup>4)</sup>	$V_{DROPOUT}$	$I_L = 100\ \mu\text{A}$			40		170	$\text{mV}$
Dropout voltage <sup>4)</sup>	$V_{DROPOUT}$	$I_L = 100\ \text{mA}$			380			$\text{mV}$
Dropout voltage <sup>4)</sup>	$V_{DROPOUT}$	$I_L = 100\ \text{mA}$ , $-40^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$					650	$\text{mV}$
Dropout supply current	$I_{SS}$	$V_{INPUT} = 4.5\ \text{V}$ , $I_L = 100\ \mu\text{A}$ <sup>8)</sup>			1.2		1.6	$\text{mA}$
Thermal regulation <sup>5)</sup>	$V_{Ttr}$	$T_J = +25^\circ\text{C}$ , $I_L = 50\ \text{mA}$ , $V_{INPUT} = 26\ \text{V}$ , $T = 10\ \text{ms}$			0.05		0.25	$\%/W$
Current limit	$I_{Lmax}$	OUTPUT tied to $V_{SS}$			450			$\text{mA}$
OUTPUT noise, 10 Hz to 100 kHz	$V_{NOISE}$				200			$\mu\text{V rms}$
Threshold voltage	$V_{TH}$	Version: AA, AG, AM	1.77	1.84	1.95	2.04	2.17	$\text{V}$
	$V_{TH}$	Version: AB, AH, AN	2.09	2.18	2.32	2.41	2.55	$\text{V}$
	$V_{TH}$	Version: AC, AI, AO	2.48	2.59	2.73	2.86	3.03	$\text{V}$
	$V_{TH}$	Version: AD, AJ, AP	3.11	3.23	3.42	3.59	3.80	$\text{V}$
	$V_{TH}$	Version: AE, AK, AQ	3.55	3.70	3.88	4.08	4.32	$\text{V}$
Threshold hysteresis	$V_{HYS}$				25			$\text{mV}$
RES Output Low Level	$V_{OL}$	$V_{OUTPUT} = 5\ \text{V}$ , $I_{OL} = 8\ \text{mA}$			175		400	$\text{mV}$
	$V_{OL}$	$V_{OUTPUT} = 3\ \text{V}$ , $I_{OL} = 4\ \text{mA}$			140		300	$\text{mV}$
	$V_{OL}$	$V_{OUTPUT} = 1\ \text{V}$ , $I_{OL} = 50\ \mu\text{A}$			20		90	$\text{mV}$
RES Output High Level <sup>7)</sup>	$V_{OH}$	$V_{OUTPUT} = 5\ \text{V}$ , $I_{OH} = -8\ \text{mA}$	4.3		4.5			$\text{V}$
	$V_{OH}$	$V_{OUTPUT} = 3\ \text{V}$ , $I_{OH} = -4\ \text{mA}$	2.3		2.6			$\text{V}$
	$V_{OH}$	$V_{OUTPUT} = 1\ \text{V}$ , $I_{OH} = -100\ \mu\text{A}$	850		950			$\text{mV}$
Leakage current <sup>6)</sup>	$I_{LEAK}$	$V_{OUTPUT} = 5\ \text{V}$			0.05		1	$\mu\text{A}$

Table 3

- 1) If INPUT is connected to  $V_{SS}$ , no reverse current will flow from the OUTPUT to the INPUT, however the supply current specified will be sunk by the OUTPUT to supply the A 6300.
- 2) The OUTPUT voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.
- 3) Regulation is measured at constant junction temperature using pulse testing with a low duty cycle. Changes in OUTPUT voltage due to heating effects are covered in the specification for thermal regulation.
- 4) The dropout voltage is defined as the INPUT to OUTPUT differential, measured with the input voltage equal to 5.0 V.
- 5) 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.
- 6) Only for open drain versions.
- 7) For push-pull output only
- 8) Reset output open



## Timing Characteristics

$V_{\text{OUTPUT}} = 5.0 \text{ V}$ ,  $C_L = 10 \mu\text{F} + 100 \text{ nF}$ ,  $C_{\text{INPUT}} = 22 \mu\text{F}$ ,  $T_J = -40 \text{ to } +85^\circ\text{C}$ , unless otherwise specified

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Power-on Reset time	$t_{\text{POR}}$	$V_{\text{OUTPUT}} = 5 \text{ V to } 3 \text{ V in } 5 \mu\text{s}$	25	50	75	ms
Sensitivity <sup>1)</sup>	$t_{\text{SEN}}$		20	$0.8 \cdot t_{\text{R}}$		$\mu\text{s}$
Propagation time <sup>1)</sup>	$t_{\text{R}}$		22	75	200	$\mu\text{s}$

<sup>1)</sup> Tested on version with  $V_{\text{TH}}$  higher than 3 V

Table 4

## Timing Waveforms

### Voltage Monitoring

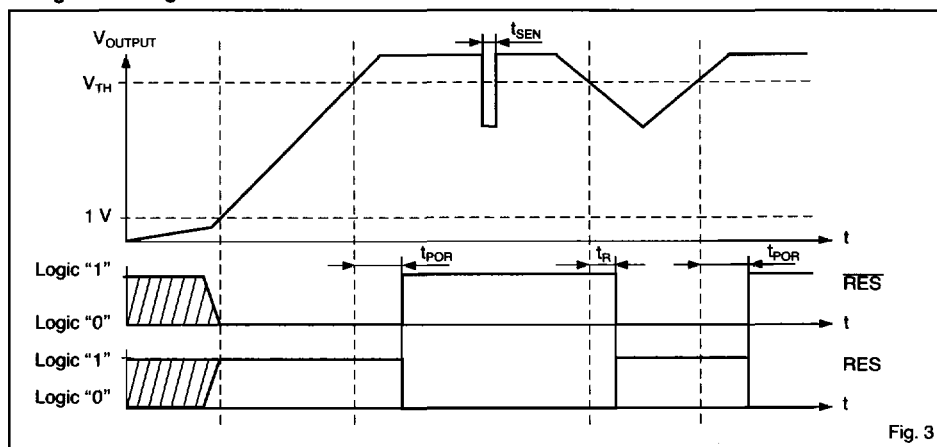


Fig. 3

## Block Diagram

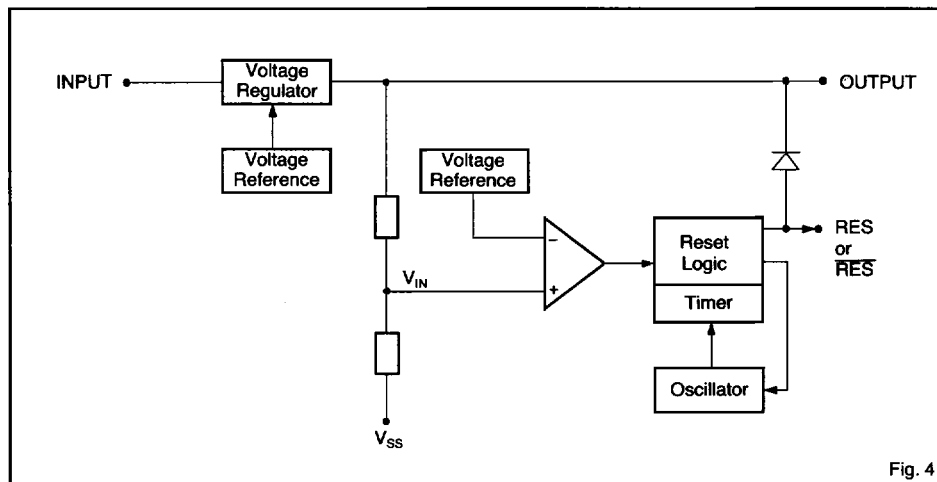


Fig. 4



## Pin Description

Pin	Name	Function
1	RES or RES	Reset output
2	V <sub>SS</sub>	Supply ground
3	N.C.	Not connected
4	N.C.	Not connected
5	N.C.	Not connected
6	INPUT	Unregulated positive supply
7	OUTPUT	Regulated output
8	N.C.	Not connected

Table 5

## Functional Description

### Voltage Regulator

The A 6300 has a  $5\text{ V} \pm 2\%$ , 100 mA, low dropout voltage regulator. The low supply current (typ. 100  $\mu\text{A}$ ) makes the A 6300 particularly suited to automotive systems then remain energized 24 hours a day. The input voltage range is 2.3 V to 26 V for operation and the input protection includes both reverse battery (20 V below ground) and load dump (positive transients up to 60 V). There is no reverse current flow from the OUTPUT to the INPUT when the INPUT equals V<sub>SS</sub>. This feature is important for systems which need to implement (with capacitance) a minimum power supply hold-up time in the event of power failure. To achieve good load regulation a 22  $\mu\text{F}$  capacitor (or greater) is needed on the INPUT (see Fig. 5). Tantalum or aluminium electrolytics are adequate for the 22  $\mu\text{F}$  capacitor; film types will work but are relatively expensive. Many aluminium electrolytics have electrolytes that freeze at about  $-30^\circ\text{C}$ , so tantalums are recommended for operation below  $-25^\circ\text{C}$ . The important parameters of the 22  $\mu\text{F}$  capacitor are an effective series resistance of  $\leq 5\ \Omega$  and a resonant frequency above 500 kHz.

A 10  $\mu\text{F}$  capacitor (or greater) and a 100 nF capacitor are required on the OUTPUT to prevent oscillations due to instability. The specification of the 10  $\mu\text{F}$  capacitor is as per the 22  $\mu\text{F}$  capacitor on the INPUT (see previous paragraph).

The A 6300 will remain stable and in regulation with no external load and the dropout voltage is typically constant as the input voltage fall to below its minimum level (see Table 2). These features are especially important in CMOS RAM keep-alive applications.

### Voltage Monitoring

The power-on reset and the power-down reset are generated internally with a voltage comparison of the voltage reference and the resistor divider (see Fig. 4).

At power-up the reset output (RES) is held low (see Fig. 3). After OUTPUT reaches V<sub>TH</sub>, the RES output is held low for an additional power-on reset delay t<sub>POR</sub> (typically 50 ms). The power-on reset delay prevents repeated toggling of RES even if V<sub>OUTPUT</sub> and the INPUT voltage drops out and recovers. The POR delay allows the microprocessor's crystal oscillator time to stabilize and to ensure correct recognition of the reset signal to the microprocessor.

The RES output goes active low generating the power-down reset whenever V<sub>OUTPUT</sub> falls below V<sub>TH</sub>. The sensitivity or reaction time of the internal comparator to the voltage level on V<sub>IN</sub> is typically 70  $\mu\text{s}$ .

### Temperature Consideration

Care must be taken not to exceed the maximum junction temperature ( $+125^\circ\text{C}$ ). The power dissipation within the A 6300 is given by the formula:

$$P_{\text{TOTAL}} = (V_{\text{INPUT}} - V_{\text{OUTPUT}}) \cdot I_{\text{OUTPUT}} + (V_{\text{INPUT}}) \cdot I_{\text{SS}}$$

The maximum continuous power dissipation at a given temperature can be calculated using the formula:

$$P_{\text{max}} = (125^\circ\text{C} - T_{\text{A}}) / R_{\text{th(j-a)}}$$

where R<sub>th(j-a)</sub> is the thermal resistance from the junction to the ambient and is specified in Table 2. Note the R<sub>th(j-a)</sub> given in Table 2 assumes that the package is soldered to a PCB. The above formula for maximum power dissipation assumes a constant load (i.e.  $\geq 100\ \text{s}$ ). The transient thermal resistance for a single pulse is much lower than the continuous value. For example the A 6300 in DIP8 package will have an effective thermal resistance from the junction to the ambient of about  $10^\circ\text{C/W}$  for a single 100 ms pulse.

## OUTPUT Current versus INPUT Voltage

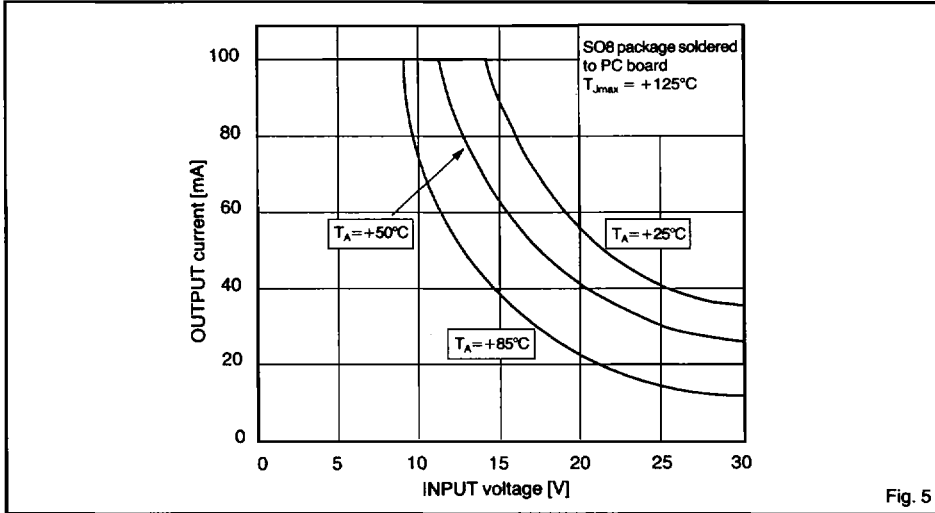


Fig. 5

## Typical Application

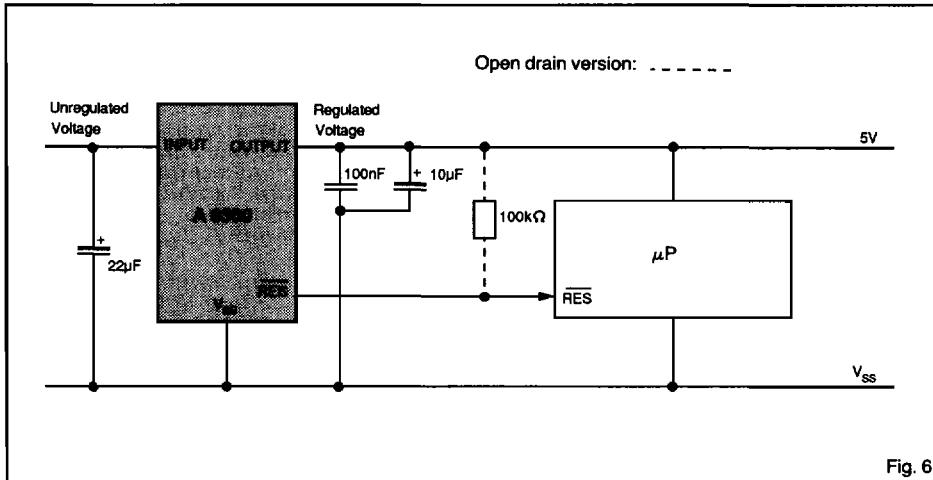
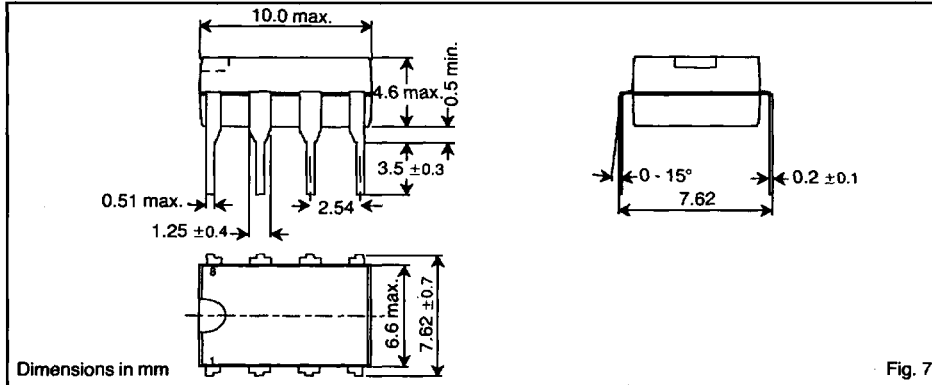


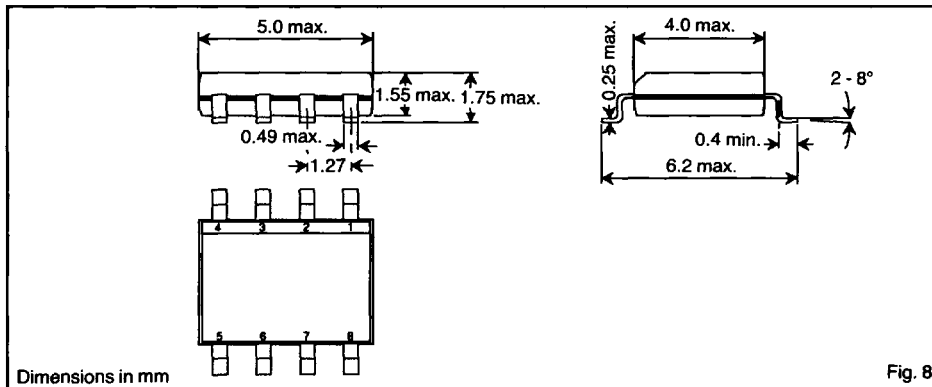
Fig. 6

## Package and Ordering Information

### Dimensions of DIP8 Package



### Dimensions of SO8 Package



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### Ordering Information

The A 6300 is available with Push-pull or Open drain output stage and Reset active low or high.

Ordering form: A 6300 <version letter> <packaging>

Example: Regulator with: - Reset active low  
- Open drain output  
- 4.0 V threshold

In DIP8 package: **A 6300 AQ 8P**

In SO8 package: **A 6300 AQ 8S**

When ordering, please specify the complete part number.

### Version letter definition

Output stage	Threshold Voltage [V]				
	2.0	2.4	2.8	3.5	4.0
Push-pull, reset active low	AA <sup>1)</sup>	AB <sup>1)</sup>	AC <sup>1)</sup>	AD <sup>1)</sup>	AE <sup>1)</sup>
Push-pull, reset active high	AG <sup>1)</sup>	AH <sup>1)</sup>	AI <sup>1)</sup>	AJ <sup>1)</sup>	AK <sup>1)</sup>
Open drain, reset active low	AM <sup>1)</sup>	AN <sup>1)</sup>	AO <sup>1)</sup>	AP	AQ

<sup>1)</sup> Non-stock items, minimum order 20k pieces Table 7