

Voltage regulator with watchdog for microprocessor/controller systems

UAA1300

FEATURES

- Driving circuit for external PNP power transistor with adjustable output voltage via sense path, short-circuit protected
- Additional 5 V/50 mA output for RAM buffering, short-circuit protected
- Operating voltage range: 5.7 V to 24 V
- Reset with adjustable trigger pulse length activated by output voltage < 4.6 V
- Watchdog with adjustable input trigger window
- Dual polarity reset and watchdog output pulse
- Low line detection adjustable by external resistor ratio
- Enable input to activate watchdog and driving circuit
- Low quiescent current typical: 380 μ A
- Thermal protection

GENERAL DESCRIPTION

The UAA1300 is a bipolar IC voltage regulator especially designed for use within an automotive environment and also suitable to provide enhanced facilities within many microcontroller applications. The UAA1300 provides two stabilized low-drop outputs and offers special control functions to increase system protection and reliability.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{DD}	supply voltage		+5.7	-	+24	V
I_Q	quiescent current		-	380	-	μ A
I_{sb}	standby output current		50	-	-	mA
V_{sb}	standby output voltage		+4.9	-	+5.1	V
L	load regulation		-	1	-	mV/ mA
$I_{O(p)}$	driving current external PNP		10	-	-	mA
G	transconductance (sense input)		-	+1.5	-	mA/ mV
T_{amb}	operating ambient temperature range SOT27 SOT163A	$V_{DD} = 13$ V $I_{sb} = 50$ mA	-40 -40	- -	+130 +85	$^{\circ}$ C $^{\circ}$ C
P_{tot}	total power dissipation				see Fig.7	

ORDERING INFORMATION

EXTENDED TYPE NUMBER	PACKAGE			
	PINS	PIN POSITION	MATERIAL	CODE
UAA1300	14	DIL	plastic	SOT27
UAA1300T	20	mini-pack	plastic	SOT163A

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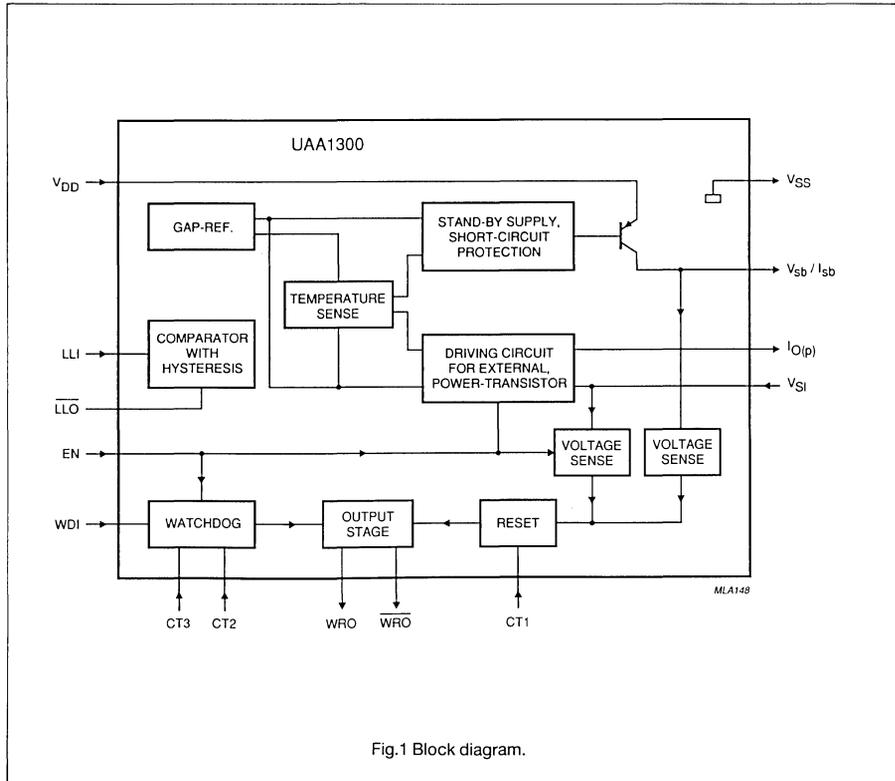
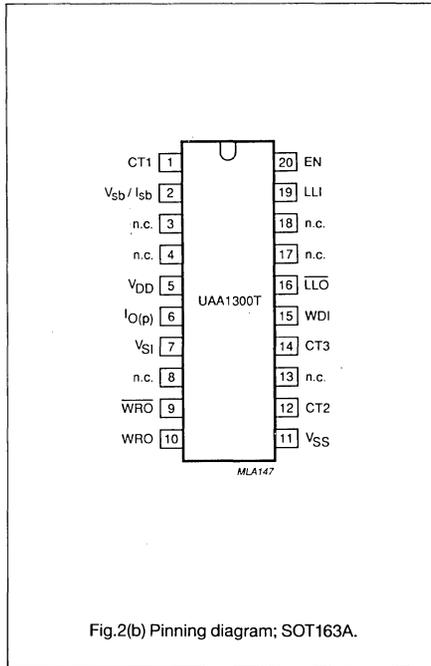
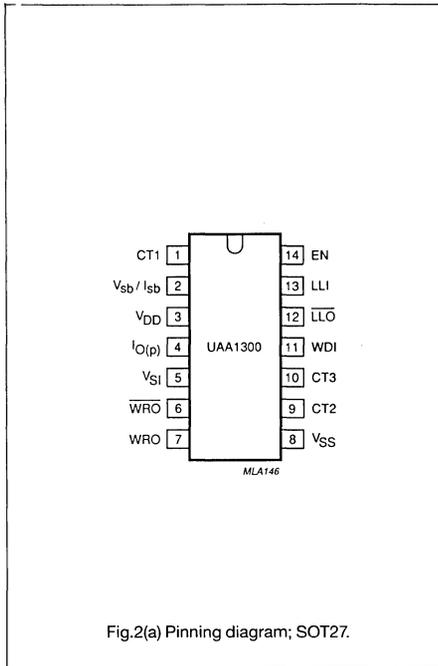


Fig.1 Block diagram.

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PINNING

SYMBOL	PIN		DESCRIPTION
	SOT27	SOT163A	
CT1	1	1	reset-length
Vsb/l sb	2	2	standby output: 5 V/50 mA
VDD	3	5	supply voltage (line)
IO(p)	4	6	driving current external pnp
VSI	5	7	sense input external pnp
WRO	6	9	watchdog reset output active LOW
WRO	7	10	watchdog reset output active HIGH
VSS	8	11	ground
CT2	9	12	maximum watchdog period
CT3	10	14	minimum watchdog period
WDI	11	15	watchdog input
LLO	12	16	low line output
LLI	13	19	low line input
EN	14	20	enable input

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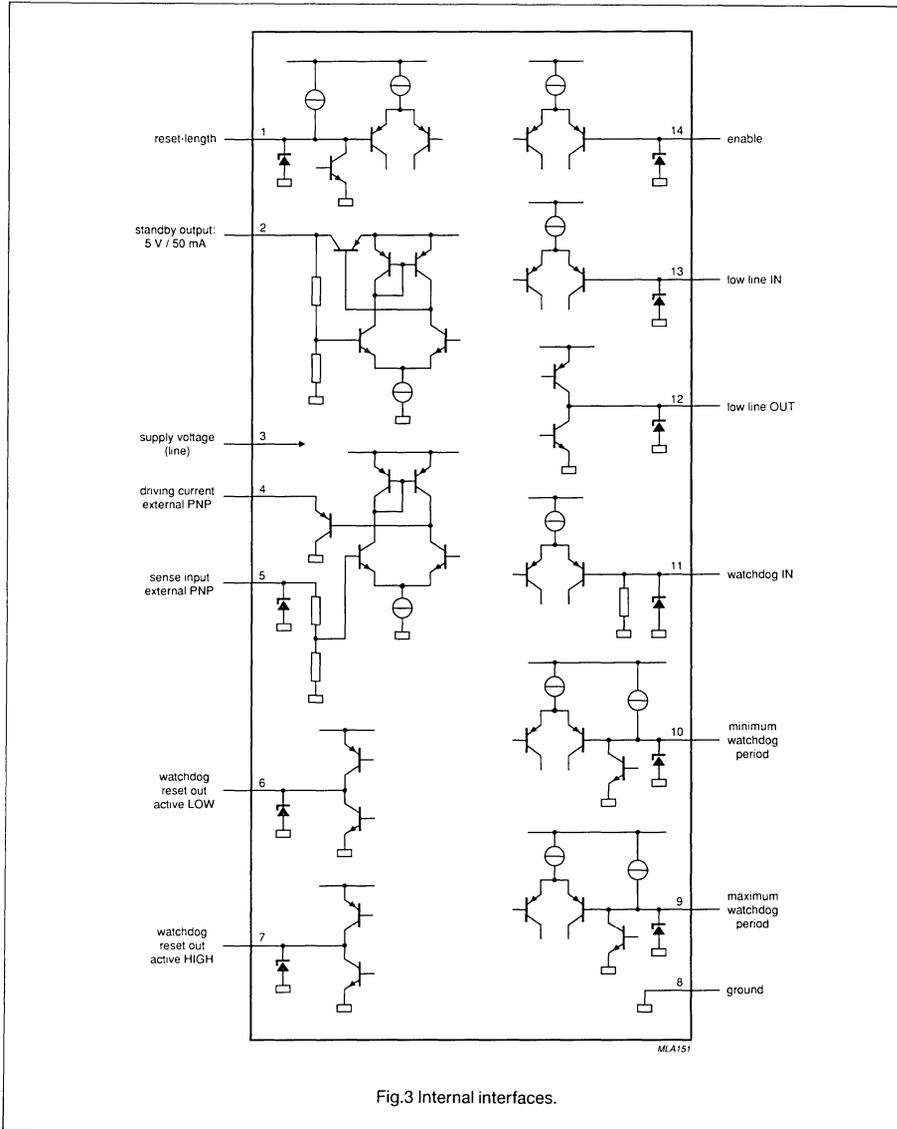


Fig.3 Internal interfaces.

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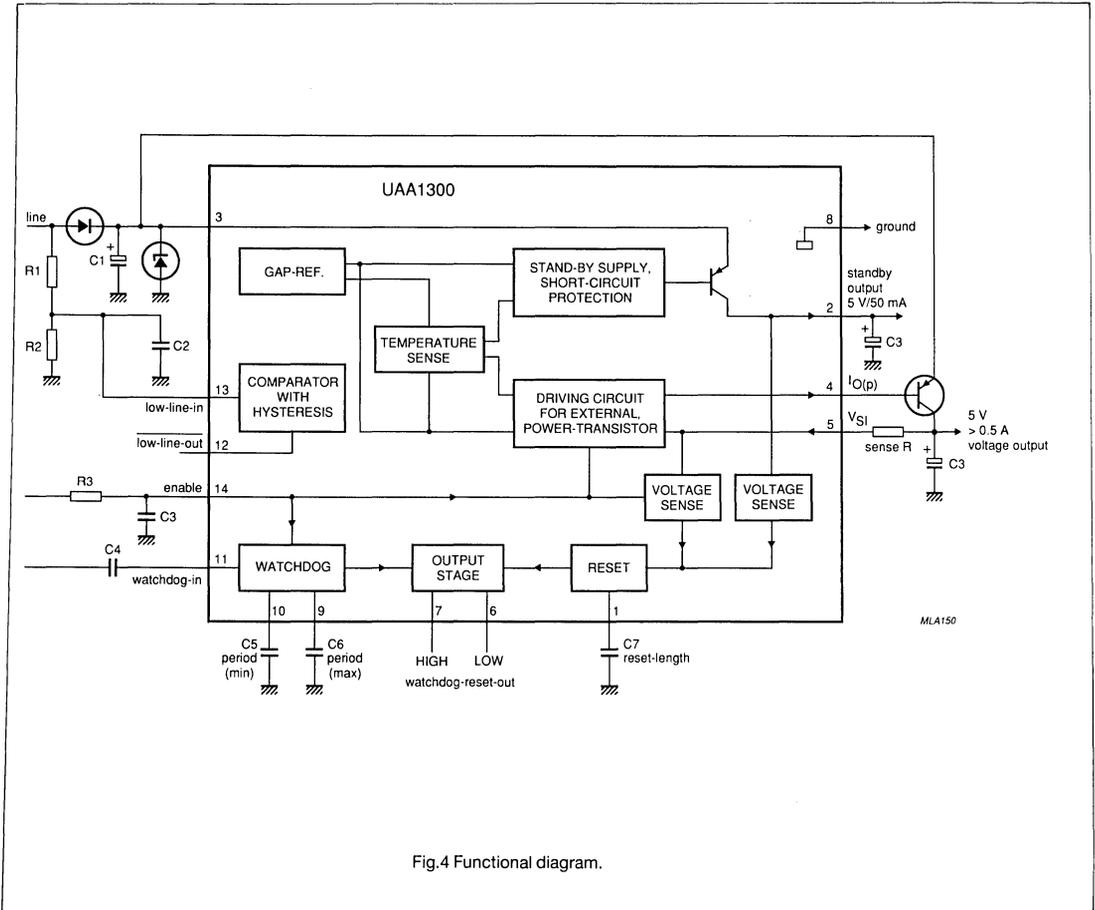


Fig.4 Functional diagram.

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FUNCTIONAL DESCRIPTION

The following features of the UAA1300 are described below:

- operating voltage range
- outputs
- \overline{WRO}/WRO activated by low output voltage
- \overline{WRO}/WRO activated by WDI pulse timing
- LLI detection
- enable input
- thermal protection

$V_{sb}/I_{sb} < 4.6 V$, the watchdog output stage is triggered by a signal from the voltage sense stages and forces a static watchdog reset output pulse (\overline{WRO}/WRO) when both the power and standby output voltage rise above 4.7 V. The duration of the pulse width is determined by the value of external capacitor C7 (see Figs 5 and 18). To operate with external series control transistor, the watchdog function must first be switched on by the enable input (EN).

\overline{WRO}/WRO activated by watchdog input pulse (WDI) timing

The watchdog input pulse (WDI) from the $\mu C/\mu P$ must be received within a time window determined by external capacitors C5 and C6. When this is not achieved the watchdog output stage generates a \overline{WRO}/WRO pulse with fixed width of 40 μs . Each rising edge at WDI restarts the timing cycle (see Figs 6 and 19). To operate, this watchdog function must first be switched on by the enable input (EN).

Operating voltage range

The UAA1300 operates within a supply voltage range of +5.7 V to +24 V and provides reverse polarity protection and low line voltage detection.

Outputs

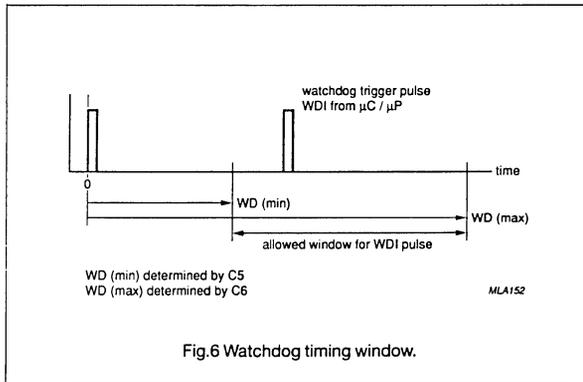
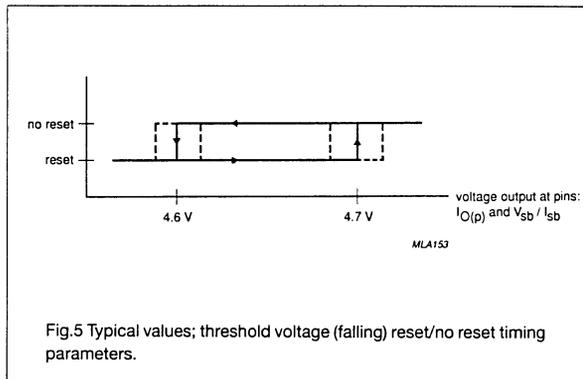
Two stabilized short-circuit protected; low drop outputs are provided:

Output current $I_{O(p)}$ drives an external PNP power transistor when switched on by the enable input (EN). Voltage sense input (V_S) regulates the current at the external power transistor. With $R = 0 \Omega$ the voltage is $5 V \pm 100 mV$. Using a resistor $> 0 \Omega$ the output will be regulated to a voltage $> 5 V$ (see Figs 4, 16, 17).

A fixed 5 V/50 mA output V_{sb}/I_{sb} supplies for example, storage circuits in microprocessor/controller systems. Not switched by enable input (EN).

\overline{WRO}/WRO activated by low output voltage

When either power or standby output voltage (pinning references $I_{O(p)}$,



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LLI detection

The UAA1300 provides detection for low line input (LLI).

This is achieved by use of a comparator which generates a low line output pulse (LLO) on detection of a low line input voltage (LLI) < 1.24 V. When the LLI < 1.24 V it is considered LOW (V). When the LLI > 1.34 V it is considered HIGH (V). The threshold voltage is adjusted by the external resistor ratio of R1/R2.

An additional external capacitor C2 prevents an initiation of an LLO pulse which might otherwise be caused by short duration (transient) LLI voltage drops (see Fig.4).

Enable input

When the Enable input (EN) is > 2 V the driving circuit for the external power transistor is switched on and the watchdog functions are activated.

Thermal protection

Outputs (pinning references I_{O(p)} and V_{sb}/I_{sb}) are controlled by an internal temperature sense switch module which operates at a crystal temperature > 150 °C switching off these outputs. The temperature sense switch resets at a crystal temperature ≤ +130 °C and switches on both outputs.

LIMITING VALUES

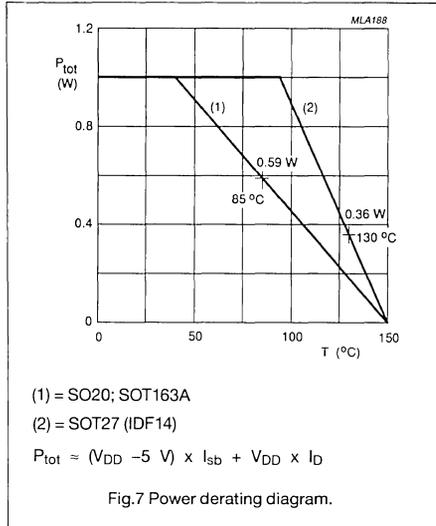
In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
T _{amb}	operating ambient temperature range SOT27 SOT163A	V _{DD} = 13 V I _{sb} = 50 mA	-40 -40	- -	+130 +85	°C °C
P _{tot}	total power dissipation				see Fig.7	
T _{stg}	storage temperature range		-55	-	+150	°C
V _{DD}	supply voltage (reverse polarity protected)		-25	-	+25	V
V _{DD}	supply voltage	t = 2 ms	-	-	+30	V
V _I	input voltages (all inputs)		-0.5	-	+7	V
I _I	input current (all inputs)		-5	-	5	mA
V _O	output voltages (LLO, WRO)		-	-	+7	V
I _O	output current (LLO, WRO)		-	-	10	mA
V _{O(p)}	output voltage (power)		-0.5	-	V _{DD}	V
I _{O(p)}	output current (power)		-	-	25	mA
V _{sb}	output voltage (standby)		-	-	V _{DD}	V
I _{sb}	output current (standby)		-	-	100	mA
Dynamic limits; transient voltage:						
V _{ES}	electrostatic handling *	V _{ES} for all pins	-2000	-	+2000	V

* Electrostatic handling is equivalent to discharging a 100 pF capacitor through a 1.5 kΩ series resistor with a 15 ns rise time.

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CHARACTERISTICS

$V_{\text{DD}} = 13 \text{ V}$, $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{DD}	supply voltage range for logic functions		+4.2	-	+24	V
I_{DD}	supply current without load	input EN = LOW	-	380	-	μA
T_{amb}	operating ambient temperature range		-40	-	+130	$^\circ\text{C}$
Standby output						
V_{sb}	output voltage	$V_{\text{DD min}} = +5.7 \text{ V}$	+4.9	+5	+5.1	V
I_{sb}	current capability		-50	-	-	mA
L	load regulation		-	-	1	mV/mA
TC_{sb}	temperature coefficient of output voltage		-	± 400	-	$\mu\text{V}/^\circ\text{C}$
RR	ripple rejection	$f = 100 \text{ Hz}$	-	50	-	dB
Reference for external pnp-transistor						
I_{O}	current capability		10	-	-	mA
V_{O}	limits for external voltage		+5	-	V_{DD}	V
G	transconductance (sense input)		0.4	1.5	-	mA/mV
I_{S}	sense current	$V_{\text{SI}} = +5\text{V}$	37.5	50	62.5	μA
R_{S}	input resistance		75	100	125	k Ω
Temperature sense						
δS	threshold for rising temperature		-	+150	-	$^\circ\text{C}$
$\delta\Delta$	hysteresis of temperature sense		-	+30	-	$^\circ\text{C}$

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Low-line detection						
$I_{LLI/LOW}$	input current LOW		-	-	-0.2	μA
V_{THL}	threshold voltage for falling voltage	temperature range $-40^{\circ}C$ to $+130^{\circ}C$	+1.22	+1.24	+1.26	V
V_{THU}	hysteresis		+90	+100	+110	mV
T_C	temperature coefficient for hysteresis		-	+300	-	$\mu V/^{\circ}C$
Low-line output						
V_{OL}	output voltage LOW	$I_{OL} = 2\text{ mA}$	-	-	+0.4	V
V_{OH}	output voltage HIGH	$I_{OH} = 50\ \mu A$	+3.4	-	-	V
Enable input						
V_{IL}	enable input voltage LOW		-	-	+0.8	V
I_{IL}	enable input current LOW		-	-	-0.1	μA
V_{IH}	enable input voltage HIGH		+2	-	-	V
Watchdog input						
V_{LW}	watchdog input voltage LOW		-	-	+0.8	V
I_{LW}	watchdog input current LOW		-	-	-0.2	μA
V_{HW}	watchdog input voltage HIGH		+2	-	-	V
Z_I	input impedance		28	50	72	$k\Omega$
t_{WDI}	minimum input pulse length		40	-	-	μs
Minimum and maximum Watchdog Period						
I_{WD}	output current (pin shorted to ground)		-1	-1.25	-1.50	μA
t_{CIWD}	temperature coefficient of output current		-	-0.6	-	$\%/^{\circ}C$
V_{TH}	threshold for internal comparator		-	+1.24	-	V
Timing of watchdog function						
Range of useful external film-capacitors: 100 pF to 1 μF (C5/C6)						
t_{WP}	watchdog minimum period	$C5 = 100\text{ pF}$	70	100	130	μs
t_{WP}	watchdog maximum period	$C6 = 1\ \mu F$	700	1000	1300	ms
t_{WDO}	duration of the watchdog output pulse		25	40	55	μs
Reset function: timing						
t_{RO}	duration of the reset pulse	$C7 = 100\text{ pF}$	-	100	-	μs
t_{RO}	duration of the reset pulse	$C7 = 100\text{ nF}$	-	100	-	ms
Reset function: DC conditions						
V_{th}	threshold voltage (falling) for reset on		4.5	4.6	4.7	V
δ	hysteresis		-	100	-	mV
T_C	temperature coefficient of hysteresis		-	100	-	$\mu V/^{\circ}C$

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TEST VALUES, ADJUSTMENTS AND APPLICATION EXAMPLE

The following figures (Figs 8 to 19) provide a test circuit, typical test values and voltage and timing adjustments. Figure 20 provides an application example for automotive environment.

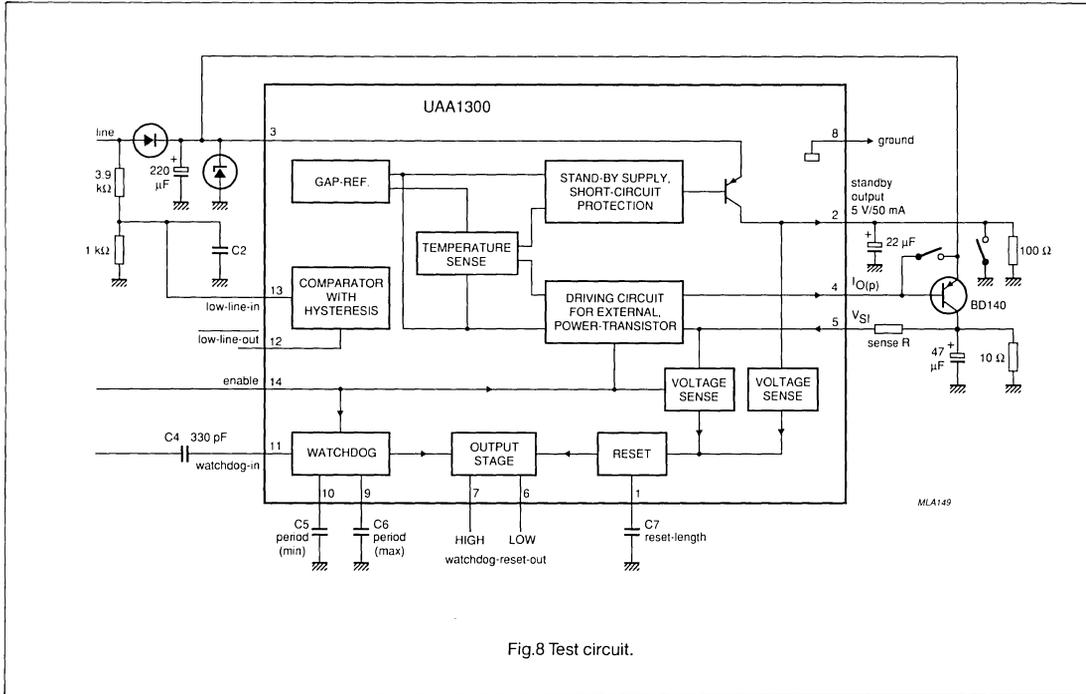


Fig.8 Test circuit.

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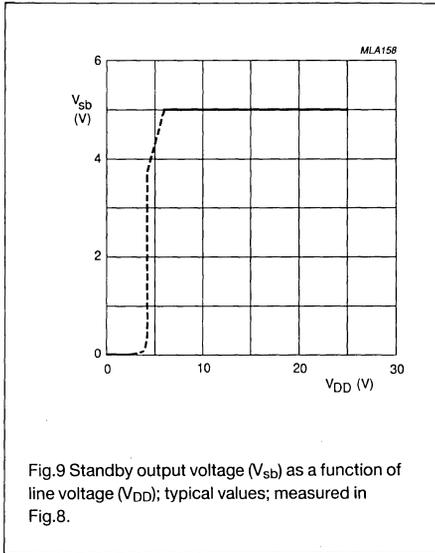


Fig.9 Standby output voltage (V_{sb}) as a function of line voltage (V_{DD}); typical values; measured in Fig.8.

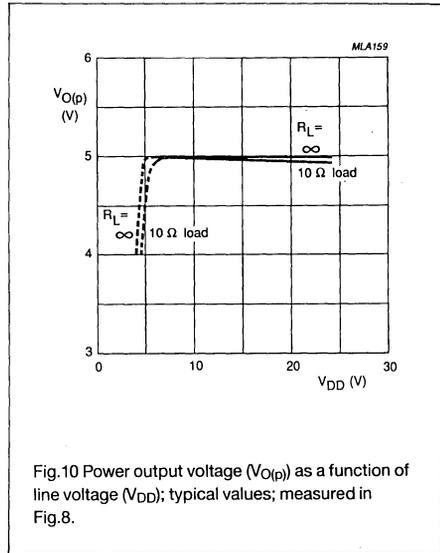


Fig.10 Power output voltage ($V_{O(p)}$) as a function of line voltage (V_{DD}); typical values; measured in Fig.8.

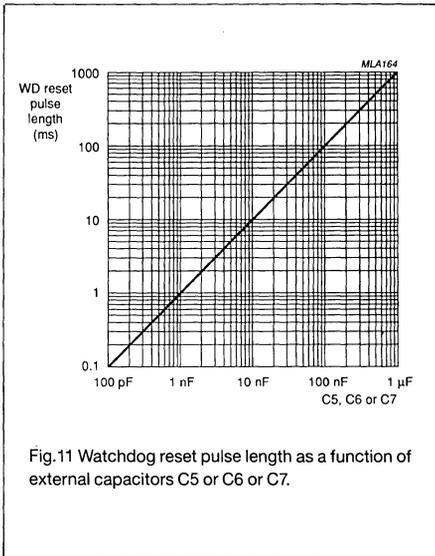


Fig.11 Watchdog reset pulse length as a function of external capacitors C5 or C6 or C7.

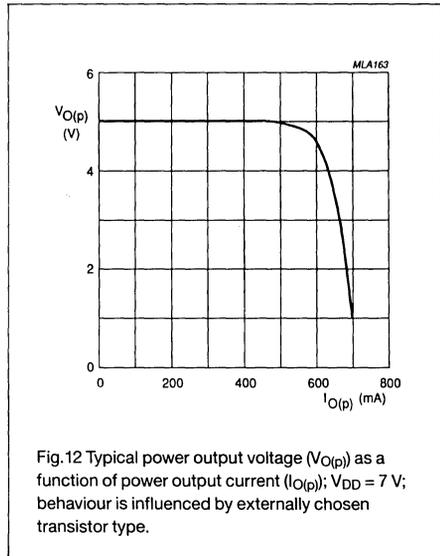


Fig.12 Typical power output voltage ($V_{O(p)}$) as a function of power output current ($I_{O(p)}$); $V_{DD} = 7$ V; behaviour is influenced by externally chosen transistor type.

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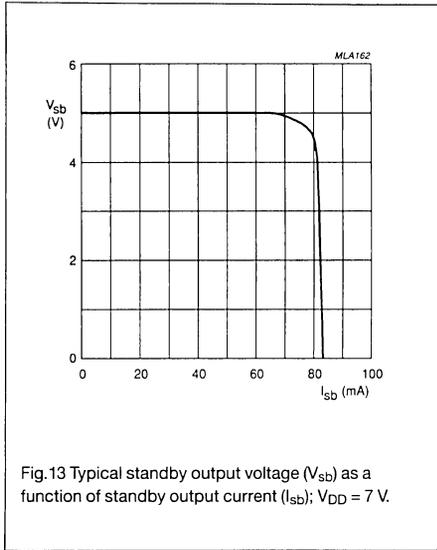


Fig.13 Typical standby output voltage (V_{sb}) as a function of standby output current (I_{sb}); $V_{DD} = 7$ V.

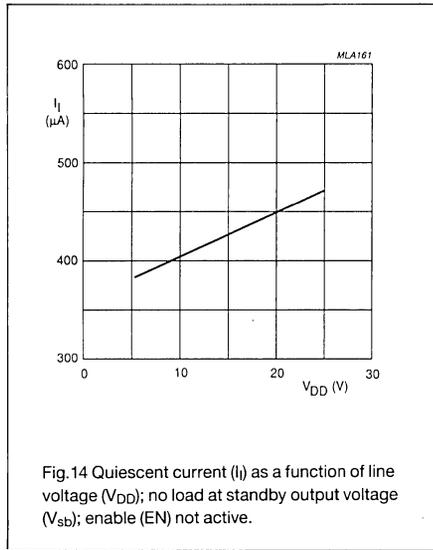


Fig.14 Quiescent current (I_i) as a function of line voltage (V_{DD}); no load at standby output voltage (V_{sb}); enable (EN) not active.

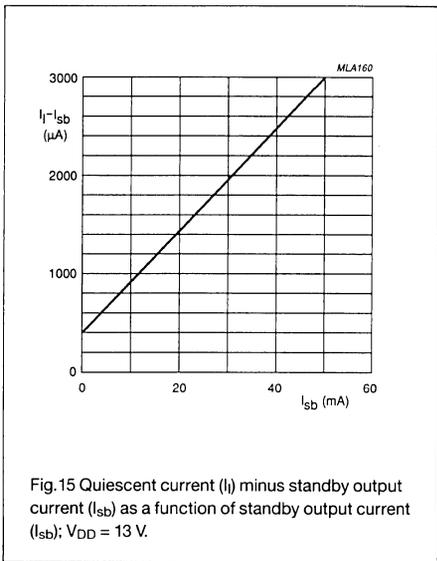


Fig.15 Quiescent current (I_i) minus standby output current (I_{sb}) as a function of standby output current (I_{sb}); $V_{DD} = 13$ V.

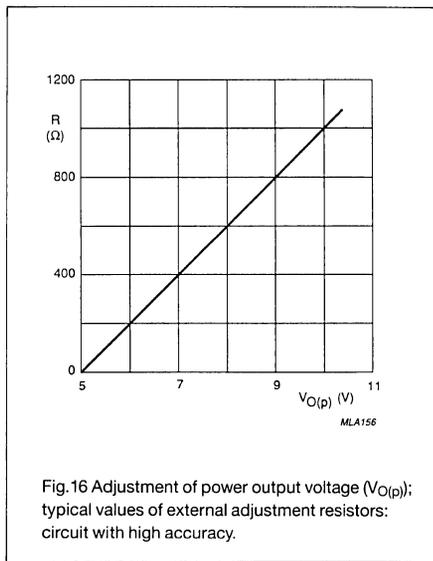


Fig.16 Adjustment of power output voltage ($V_{O(p)}$); typical values of external adjustment resistors: circuit with high accuracy.

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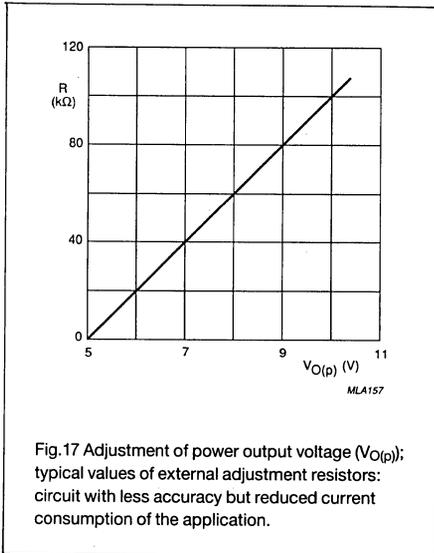


Fig. 17 Adjustment of power output voltage ($V_{O(p)}$); typical values of external adjustment resistors: circuit with less accuracy but reduced current consumption of the application.

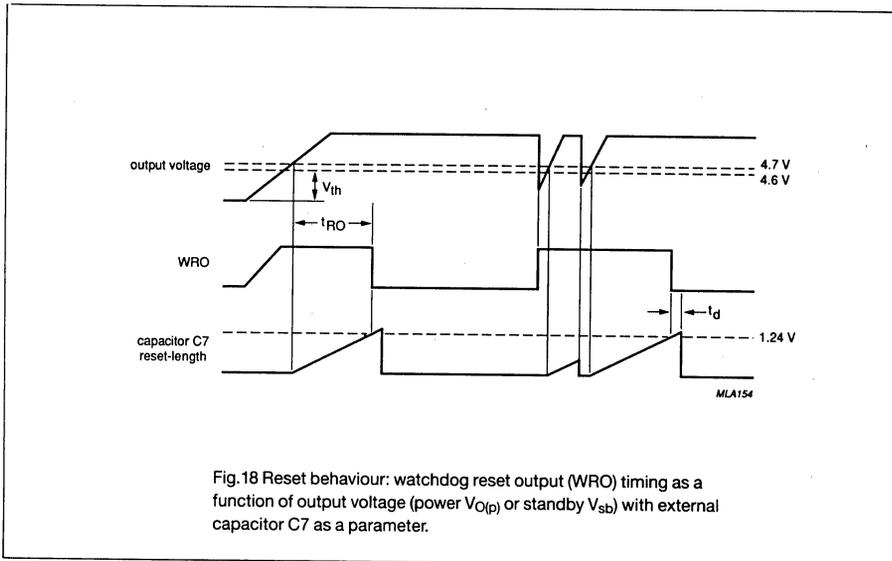


Fig. 18 Reset behaviour: watchdog reset output (WRO) timing as a function of output voltage (power $V_{O(p)}$ or standby V_{sb}) with external capacitor C7 as a parameter.

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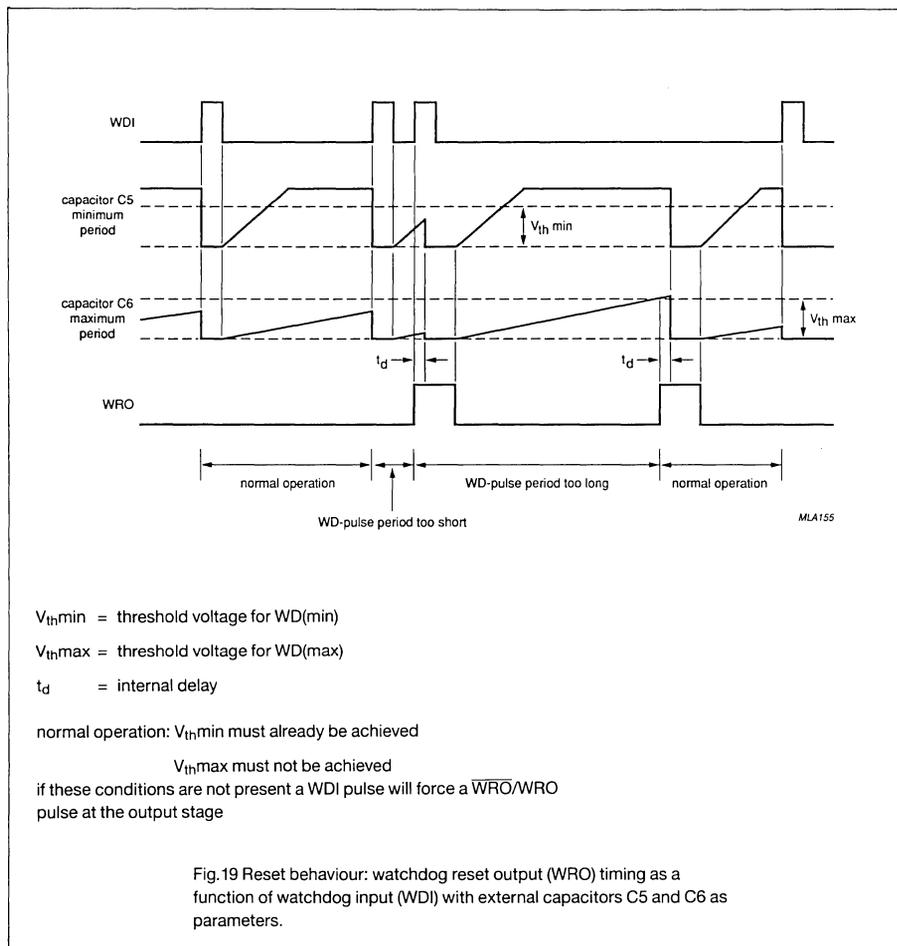


Fig. 19 Reset behaviour: watchdog reset output (WRO) timing as a function of watchdog input (WDI) with external capacitors C5 and C6 as parameters.

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APPLICATION INFORMATION

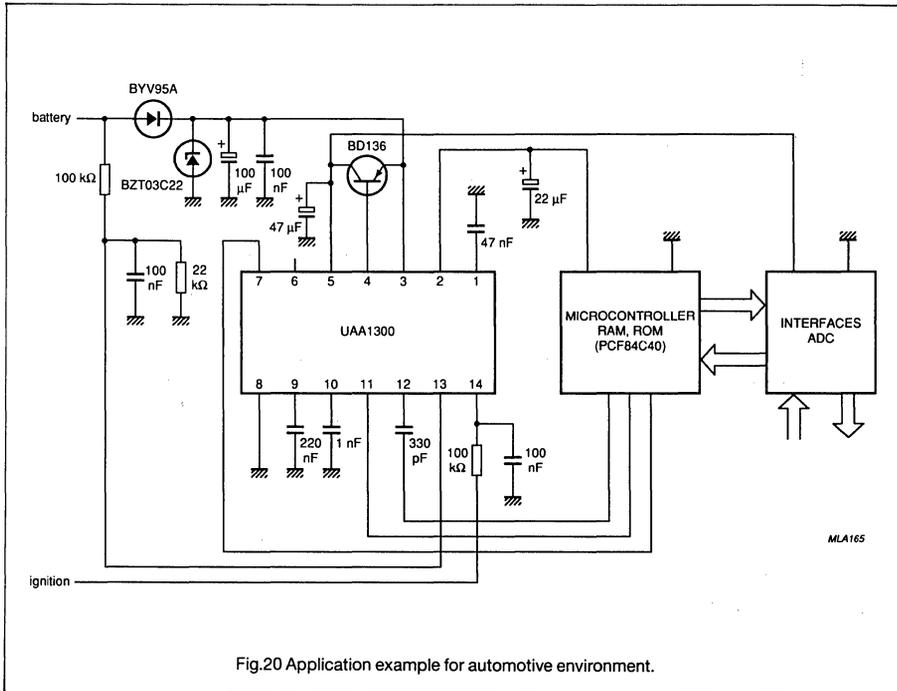


Fig.20 Application example for automotive environment.