VOLTAGE TRANSMITTER IC AM411

FEATURES

- **Wide Supply Voltage Range: 6...35V**
- **Wide Operating Temperature Range: –40°C ...+85°C**
- **Voltage Reference: 5V**
- **Instrumentation Amplifier Input (Reversible Polarity)**
- **Operational Amplifier Input**
- **Adjustable Gain and Offset**
- **Adjustable Output Voltage Range: 0.5...4.5V, 0...5/10V, other**
- **Protection Against Reverse Polarity**
- **Output Current Limitation**

APPLICATIONS

- Industrial Process Control
- Sensor Transmitter (e.g. pressure)
- Programmable Voltage Source

GENERAL DESCRIPTION

The AM411 is a monolithic voltage transmitter, designed for flexible bridge input signal conditioning. The integrated circuit is ideally suited for a wide variety of transducers with an differential output signal. It contains a high accuracy instrumentation amplifier for differential input signals, an operational amplifier output stage, and a 5V reference. Output range and gain are adjustable by external resistors. Using the internal instrumentation amplifier the AM411 is a standard sensor transmitter with the possibility to indicate an over range signal. With the internal connected operational amplifier input this IC can be used as an adjustable voltage–to–voltage transmitter.

DELIVERY

- DIL8 packages (samples)
- SOP8 packages
- Dice on 5“ blue foil

BLOCK DIAGRAM

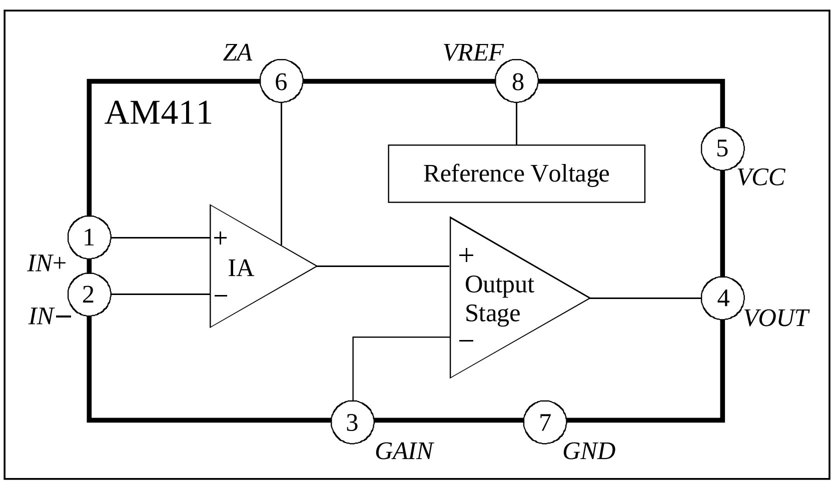

Figure 1

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ELECTRICAL SPECIFICATIONS

T_{amb} = 25°C, V_{CC} = 24V, V_{REF} = 5V, I_{REF} = 1mA (unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Voltage Range	V_{CC}		6		35	V
Quiescent Current	I_{CC}	T_{amb} = – 40...+85°C, I_{REF} = 0mA			1.5	mA
Temperature Specifications						
Operating	T_{amb}		–40		85	°C
Storage	T_{st}		–55		125	°C
Junction	T_J				150	°C
Thermal Resistance	Θ_{ja}	DIL8 plastic package		110		°C/W
	Θ_{ja}	SO8 plastic package		180		°C/W
Voltage Reference						
Voltage	V_{REF}		4.75	5.00	5.25	V
Current	I_{REF}		0.2		10.0	mA
V_{REF} vs. Temperature	dV_{REF}/dT	T_{amb} = – 40...+85°C		±90	±140	ppm/°C
Line Regulation	dV_{REF}/dV	V_{CC} = 6V...35V		30	80	ppm/V
	dV_{REF}/dV	V_{CC} = 6V...35V, $I_{REF} \approx$ 5mA		60	150	ppm/V
Load Regulation	dV_{REF}/dI			0.05	0.10	%/mA
	dV_{REF}/dI	$I_{REF} \approx$ 5mA		0.06	0.15	%/mA
Load Capacitance	C_L		1.9	2.2	5.0	µF
Instrumentation Amplifier						
Internal Gain	G_{IA}		4.9	5	5.1	
Differential Input Voltage Range	V_{IN}		0		±400	mV
Common Mode Input Range	$CMIR$	V_{CC} < 9V	1.5		V_{CC} – 3	V
	$CMIR$	$V_{CC} \geq$ 9V	1.5		6.0	V
Common Mode Rejection Ratio	$CMRR$		80	90		dB
Power Supply Rejection Ratio	$PSRR$		80	90		dB
Offset Voltage	V_{OS}			±1.5	±6	mV
V_{OS} vs. Temperature	dV_{OS}/dT			±5		µV/°C
Input Bias Current	I_B			–120	–300	nA
I_B vs. Temperature	dI_B/dT			–0.35	–0.8	nA/°C
Output Voltage Range	V_{OUTIA}	V_{CC} < 9V, $V_{OUTIA} = G_{IA} V_{IN} + V_{ZA}$	0.02		V_{CC} – 3	V
	V_{OUTIA}	$V_{CC} \geq$ 9V, $V_{OUTIA} = G_{IA} V_{IN} + V_{ZA}$	0.02		6	V
Load Capacitance	C_L				250	pF
Zero Adjust Stage						
Internal Gain	G_{ZA}			1		
Input Voltage	V_{ZA}	$V_{ZA} \leq V_{OUTIA} - G_{IA} V_{IN}$	0		V_{OUTIA}	V
Offset Voltage	V_{OS}			±0.5	±2.0	mV
V_{OS} vs. Temperature	dV_{OS}/dT			±1.6	±5	µV/°C
Input Bias Current	I_B			38	100	nA
I_B vs. Temperature	dI_B/dT			24	75	pA/°C
Voltage Output Stage						
Adjustable Gain	G_{OP}		1			
Input Range	IR	V_{CC} < 10V	0		V_{CC} – 5	V
	IR	$V_{CC} \geq$ 10V	0		5	V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Voltage Output Stage (cont.)						
Power Supply Rejection Ratio	*PSRR*		80	90		dB
Offset Voltage	V_{OS}			±0.5	±2	mV
V_{OS} vs. Temperature	dV_{OS}/dT			±3	±7	µV/°C
Input Bias Current	I_B			5	12	nA
I_B vs. Temperature	dI_B/dT			3.5	10	pA/°C
Output Voltage Range	V_{OUT}	$V_{CC} < 18V$	0		$V_{CC} - 5$	V
	V_{OUT}	$V_{CC} \geq 18V$	0		13	V
Output Current Limitation	I_{LIM}	$V_{OUT} \geq 10V$	5	7	10	mA
Output Current	I_{OUT}		0		I_{LIM}	mA
Load Resistance	R_L		2			kΩ
Load Capacitance	C_L				500	nF
Protection Functions						
Protection against reverse polarity		*Ground* vs. V_S vs. V_{OUT}			35	V
System Parameters						
Nonlinearity		ideal input		0.05	0.15	%FS

Currents flowing into the IC are negative

BOUNDARY CONDITIONS

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Sum Offset Resistors	$R_3 + R_4$		20		200	kΩ
V_{REF} Capacitance	C_1		1.9	2.2	5.0	µF

FUNCTIONAL DIAGRAM

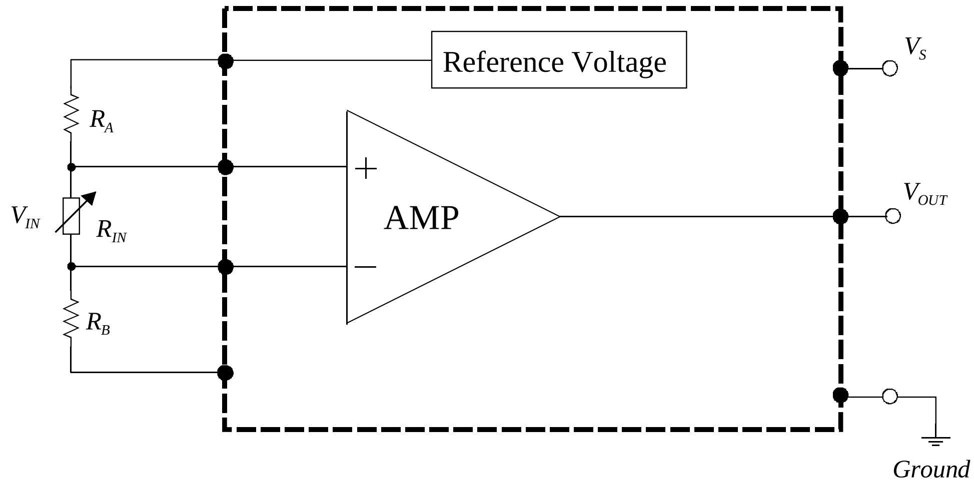

Figure 2

FUNCTIONAL DESCRIPTION

The IC AM411 is an integrated voltage transmitter for bridge input signals. With variations of a few external components the output voltage can be adjusted over a wide range. In addition to the resistors R_1 and R_2 the circuitry needs only one external capacitor C_1 for a basic application. Using the input of the voltage output stage the AM411 can be used for single ended input signals as well. Typical values for the external components are listed in the *Application Notes*.

Basically the AM411 consists of 3 functional blocks as they are shown in Figure 1:

1. A high accuracy *instrumentation amplifier* with an internal gain G_{IA} and the possibility to adjust the bias voltage (pin *ZA*) for differential input signals.
2. An *operational amplifier output stage* used for voltage transmission and as the voltage output. The output stage has an output current limitation protecting the IC.
3. A *voltage reference* can be used as an excitation for constant voltage sensors or as supply for other external devices.

The transfer function for the output voltage of the instrumentation amplifier is:

$$V_{OUTIA} = G_{IA} V_{IN} + V_{ZA}$$

with the offset voltage V_{ZA} which can be adjusted on pin *ZA*. For die entire output voltage V_{OUT} of the IC is valid

$$V_{OUT} = G_{OP} \cdot V_{INOP}$$

with the adjustable gain G_{OP}

$$G_{OP} = \frac{R_1}{R_2} + 1$$

The minimum supply voltage, which has to be adjusted, can be calculated over

$$V_S \geq V_{OUTmax} + 5V$$

PINOUT

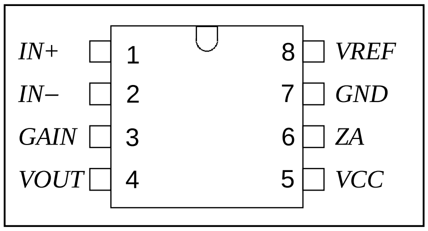

Figure 3

PIN	NAME	DESIGNATION
1	*IN+*	Non Inverting Bridge Input
2	*IN–*	Inverting Bridge Input
3	*GAIN*	Gain Adjustment
4	*VOUT*	Voltage Output
5	*VCC*	Supply Voltage
6	*ZA*	Zero Adjust
7	*GND*	IC Ground
8	*VREF*	Reference Voltage

DELIVERY

The AM411 is available in version:

- DIL8 packages (samples)
- SOP8 packages
- Dice on 5“ blue foil

PACKAGE DIMENSIONS SOP8

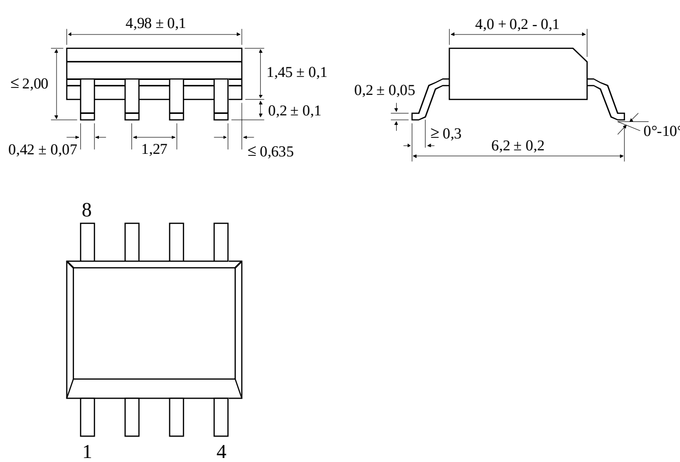

Figure 4

TYPICAL APPLICATION

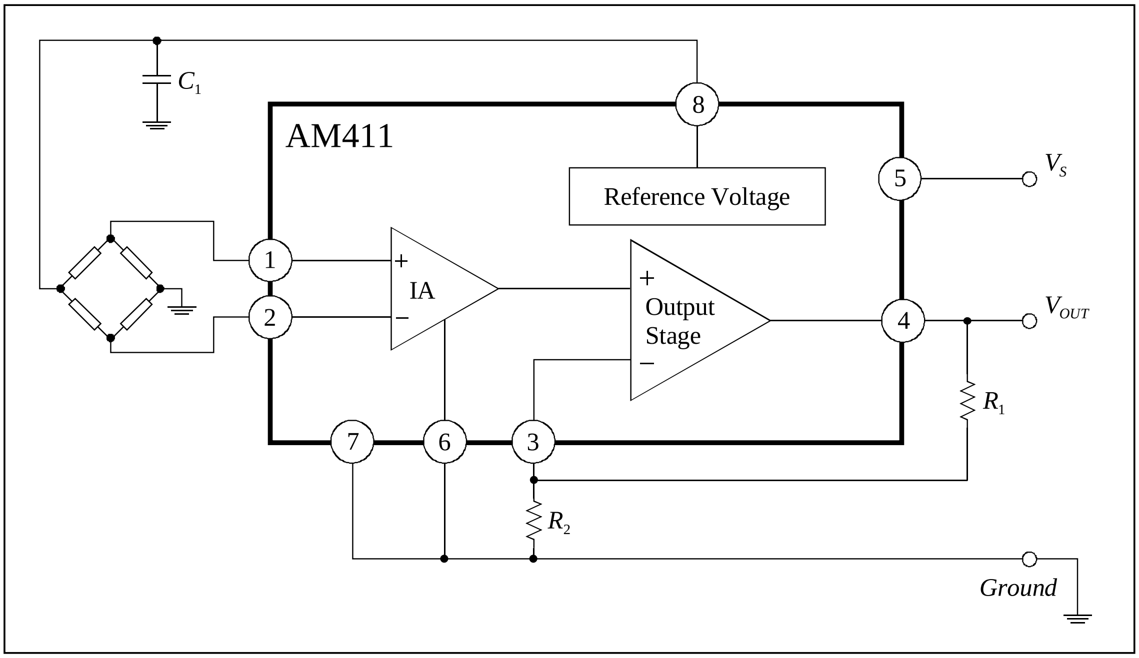

Figure 5

For Applications with an output signal of 0...5/10V zero adjust pin ZA has to be connected to IC Ground *GND* (Figure 5). The Gain G is adjusted by external resistors R_1 and R_2 and can be calculated by

$$G = G_{IA} G_{OP}$$

The transfer function of the output voltage V_{OUT} becomes

$$V_{OUT} = G\, V_{IN}$$

With this equations the external resistors R_1 and R_2 can be adjusted

$$\frac{R_1}{R_2} = \frac{V_{OUT}}{G_{IA}\, V_{IN}} - 1$$

Example 1: Output voltage range 0...10V

In this case the values of the external devices ($V_{IN} = 0 \ldots 50\text{mV}$, $R_1 / R_2 = 39$) are as follows

$R_1 \approx 39\text{k}\Omega$ $R_2 \approx 1\text{k}\Omega$ $G_{IA} = 5$ $C_1 = 2.2\mu\text{F}$

Example 2: Output voltage range 0...5V

In this case the values of the external devices ($V_{IN} = 0 \ldots 100\text{mV}$, $R_1 / R_2 = 9$) are as follows

$R_1 \approx 90\text{k}\Omega$ $R_2 \approx 10\text{k}\Omega$ $G_{IA} = 5$ $C_1 = 2.2\mu\text{F}$