Bridge Transducer Switch

FEATURES

- Dual Matched Current Sources
- High-gain Differential Sensing Circuit
- Wide Common-mode Input Capability
- Complementary Digital Open-collector Outputs
- Externally Programmable Time Delay
- Optional Output Latch with Reset
- Built-in Diagnostic Activation
- Wide Supply Voltage Range
- High Current Heater Power Source Driver

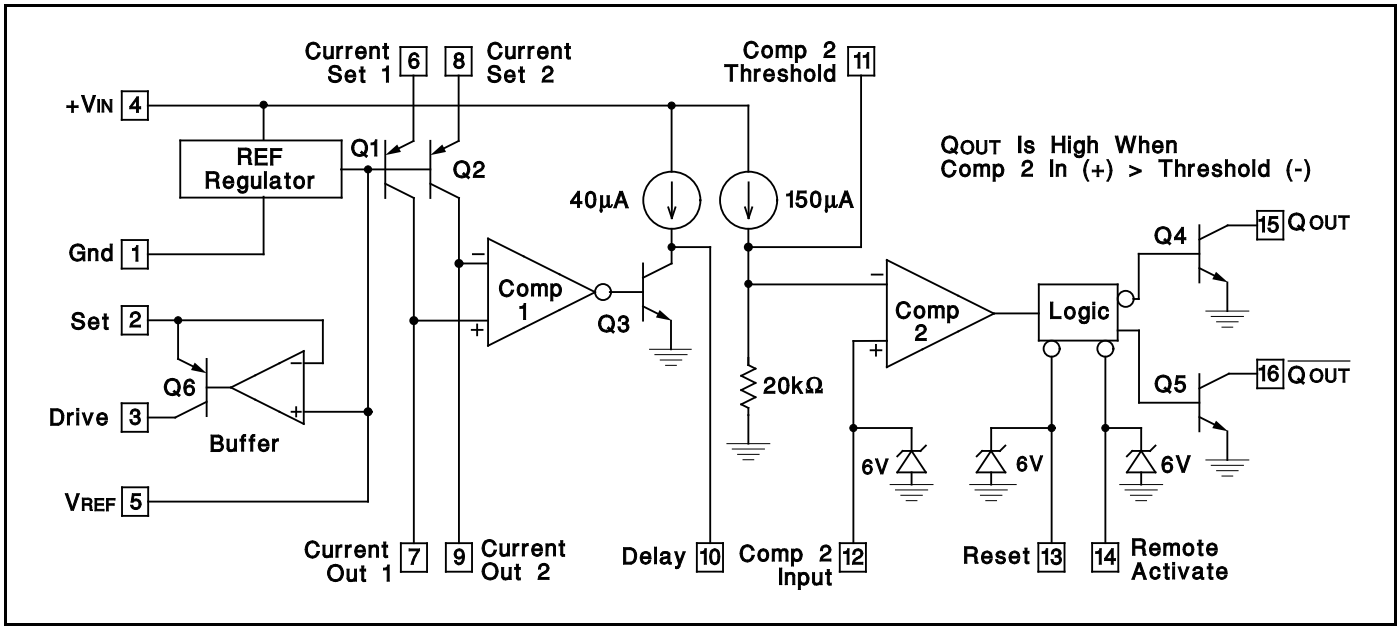
DESCRIPTION

This integrated circuit contains a complete signal conditioning system to interface low-level variable impedance transducers to a digital system. A pair of matched, temperature-compensated current sources are provided for balanced transducer excitation followed by a precision, high-gain comparator. The output of this comparator can be delayed by a user-selectable duration, after which a second comparator will switch complementary outputs separately activated for diagnostic operation and has an optional latch with external reset capability. An added feature is a high current power source useful as a heater driver in differential temperature sensing applications. The UC3704 is designed for 0°C to +70°C environments.

UC3704 COMPATIBLE SENSORS

SENSOR TYPE	ACTIVATION SOURCE						
	Temperature	Pressure	Force	Position	Displacement	Velocity	Shock
Thermistor	X					X	
Sensistor	X					X	
Thermocouple	X						
Semiconductor	X	X	X				
Photo Voltaic				X	X	X	
Photo Resistive				X	X	X	
Strain Gage		X	X	X	X	X	X
Piezoelectric		X	X		X	X	X
Magneto Resistive				X	X		
Inductive				X	X	X	X
Hall Effect				X	X		
Capacitive							X

BLOCK DIAGRAM



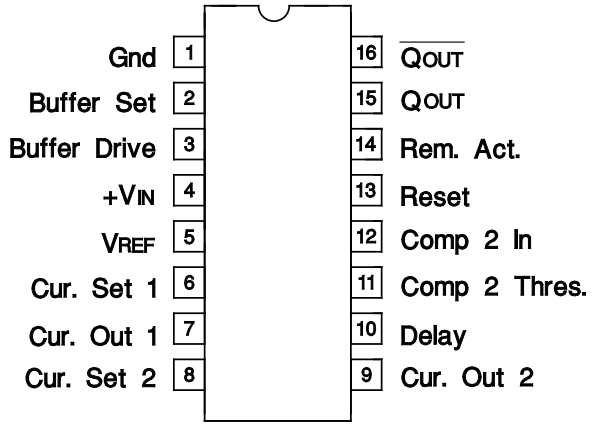
ABSOLUTE MAXIMUM RATINGS

Supply Voltage (+V_{IN}) 40V
Output Current (each output) . . . . . 50 mA
Buffer Power Source Current 200mA
Comparator 1 Inputs . . . . . -0.5V to V_{REF}
Comparator 2 Inputs . . . . . 0 to 5.5V
Remote Activation and Reset Inputs . . . . . 0 to 5.5V
Power Dissipation at T_A = 25°C 1000mW
Operating Junction Temperature . . . . . -55°C to +150°C
Storage Temperature Range . . . . . -65°C to +150°C
Lead Temperature (Soldering, 10 Seconds) . . . . . +300°C

Note: Unless otherwise specified, all voltages are with respect to ground (Pin 1).
Currents are positive into, negative out of the specified terminal.
Consult Packaging section of Databook for thermal imitations and considerations of package.

CONNECTION DIAGRAM

DIL-16 (TOP VIEW)
J or N Package



ELECTRICAL CHARACTERISTICS:

Unless otherwise stated, these specifications apply for T_A = 0°C to +70°C for the UC3704: V_{IH} = 15V, T_A = T_J.

PARAMETERS	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Power Inputs					
Supply Voltage Range		4.2		36	V
Supply Current	V_{IN} = 36V		5	10	mA
Reference Section (with respect to V_{IN})					
V_{REF} Value |V_{IN} - V_{REF}|	T_J = 25°C	2.1	2.2	2.3	V
V_{REF} Temperature Coefficient	Note 1	-1	-2	-3	mV/°C
Line Regulation	ΔV_{IN} = 4.2 to 25V		2	10	mV
Load Regulation	ΔI_O = 0 to 4mA		2	10	mV
Short Circuit Current	V_{IN} = 36V, V_{REF} = V_{IN} or Ground			±25	mA
Current Source (Q1 and Q2)					
Output Current (Note 2)	Current Set = 10µA	-9	-9.5	-10	µA
	Current Set = 200µA	-180	-195	-200	µA
Output Offset Current	R_{E6} = R_{E8} = 20kΩ		0	±1	µA
Comparator One					
Input Offset Voltage			±1	±4	mV
Input Bias Current			-100	-300	nA
Input Offset Current				±60	nA
CMRR	V_{CM} = 0 to 12V	60	70		dB
Voltage gain	R_L>150kΩ	70	85		dB
Delay Current Source		34	40	52	µA
Output Rise Time	Overdrive = 10mV, C_D = 15pF, T_J = 20°C		2		V/µs

ELECTRICAL CHARACTERISTICS: Unless otherwise stated, these specifications apply for T_A = 0°C to +70°C for the UC3704: V_{IH} = 15V, T_A = T_J.

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNITS
Comparator Two (Q_{OUT} and $\overline{Q_{OUT}}$)						
Threshold Voltage			2.2	3.0	3.8	V
Threshold Resistance	To Ground		14	20	24	kΩ
Input Bias Current	V_{IN} (Pin 12) = 5V			1	3	µA
Remote Activate Current	Pin 14 = 0V			0.2	0.5	mA
Reset Current	Pin 13 = 0V			0.2	0.5	mA
Remote Activate Threshold	T_A = 25°C		0.8	1.2		V
Reset Threshold	T_A = 25°C		0.8	1.2		V
Output Saturation	I_{OUT} = 16mA			0.2	0.5	V
	I_{OUT} = 50mA			0.7	2.0	V
Output Leakage	V_{OUT} = 40V			0.2	10	µA
Output Response	Comp. Overdrive = 1V, R_L = 5k to V_{IN}	Turn-on		0.4		µs
		Turn-off		1.0		µs
Buffer						
Set Voltage (V_{IN} -V_S)	T_J = 25°C, I_S = 100mA		1.9	2.1	2.3	V
Drive Current	T_J = 25°C, R_S = 200Ω, V_D = 0V		90	100	120	mA

Note 1: Parameter guaranteed by design, not tested in production.

Note 2: Collector output current $= \frac{V_{IN} - V_{REF} - V_{BE}}{R_E} \approx \frac{1.5V}{R_E}$

APPLICATIONS INFORMATION

Sensor Section

The input portion of the UC3704 provides both excitation and sensing for a low-level, variable impedance transducer. This circuitry consists of a pair of highly matched PNP transistors biased for operation as constant current sources followed by a high gain precision comparator.

The reference voltage at the bases of the PNP transistors has a TC to offset the base-emitter voltage variation of these transistors resulting in a constant voltage across the external emitter resistors and correspondingly constant collector currents for balancing, offsetting, or to provide unique temperature characteristic.

With the PNP transistor's optimum current ranging from 10 to 200µA, and the common-mode input voltage of the comparator usable from ground to (V_{IN} - 3V), a wide range of transducer impedance levels is possible.

The sensor comparator has a current source pull-up at the output so that an external capacitor from this point to ground can be used to provide a programmable delay before reaching the second comparator's threshold. The low-impedance on-state of Comp 1's output provides quick reset of this capacitor. This programmable delay function is useful for providing transient protection by requiring that Comp 1 remain activated for a finite period of time before Comp 2 triggers. Another application is in counting repetitive pulses where a missing pulse will allow Comp 1's output to rise to Comp 2's threshold. This time delay function is:

$$Delay = \frac{Comp2\ Threshold}{Delay\ Current}\ X\ C_D \approx 175ms/\mu F$$

If hysteresis is desired for Comparator 1, it may be accommodated by applying positive feedback from the delay terminal to the non-inverting input on Pin 7. This will aid in providing oscillation-free transitions for very slowly changing inputs.

APPLICATIONS INFORMATION (cont.)

Output Section

The output portion of the UC3704 is basically a second comparator with complimentary, open-collector outputs. This comparator has a built-in, ground-referenced threshold implemented with a high-impedance current source and resistor so that it may be easily overridden with an external voltage source if desired. Comp 2's input transistors are NPN types which require at least 1V of common-mode voltage for accurate operation and should not see a differential input voltage greater than 6V.

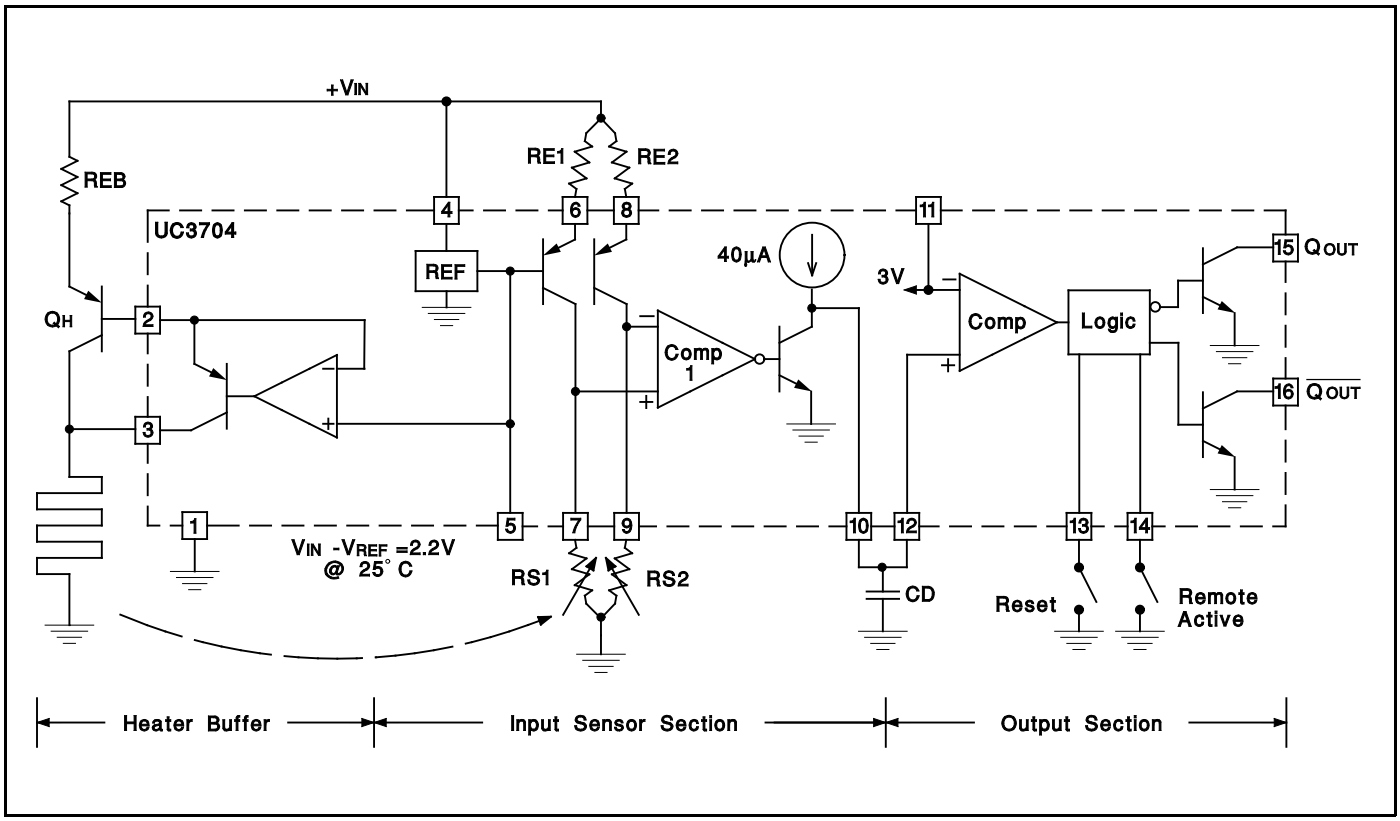
For diagnostic or latching purposes, the output logic is equipped with a Remote Activate and Reset function. These pins have internal pull-ups and are only active when pulled low below a threshold of approximately 1V. A low signal at the Remote Activate Pin causes the outputs to change state in exactly the same manner as if Comp 2's input is raised above the threshold on Pin 11. If Pin 16 is connected to Pin 14, positive feedback results and the outputs will latch once triggered by Comp 2's input. Pulling the Reset terminal low overrides the Remote Activate Pin releasing the latch.

Reference Buffer

This circuit is designed to provide up to 100mA to drive a high current external PNP transistor useful for powering a heater for differential temperature measurements. Care must be taken that power dissipation in Q6 does not cause excessive thermal gradients which will degrade the accuracy of the sensing circuitry.

Using a heating element attached to a temperature sensitive resistor, RS1, in one leg of the input bridge implements a flow sensor for either gasses or liquids. As long as there is flow, heat from the element is carried away and the sensor voltage remains below threshold. Using an identical sensor, RS2, without a heater to establish this threshold compensates for the ambient temperature of the flow.

TYPICAL APPLICATION FOR MONITORING LIQUID OR GAS FLOW



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