

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

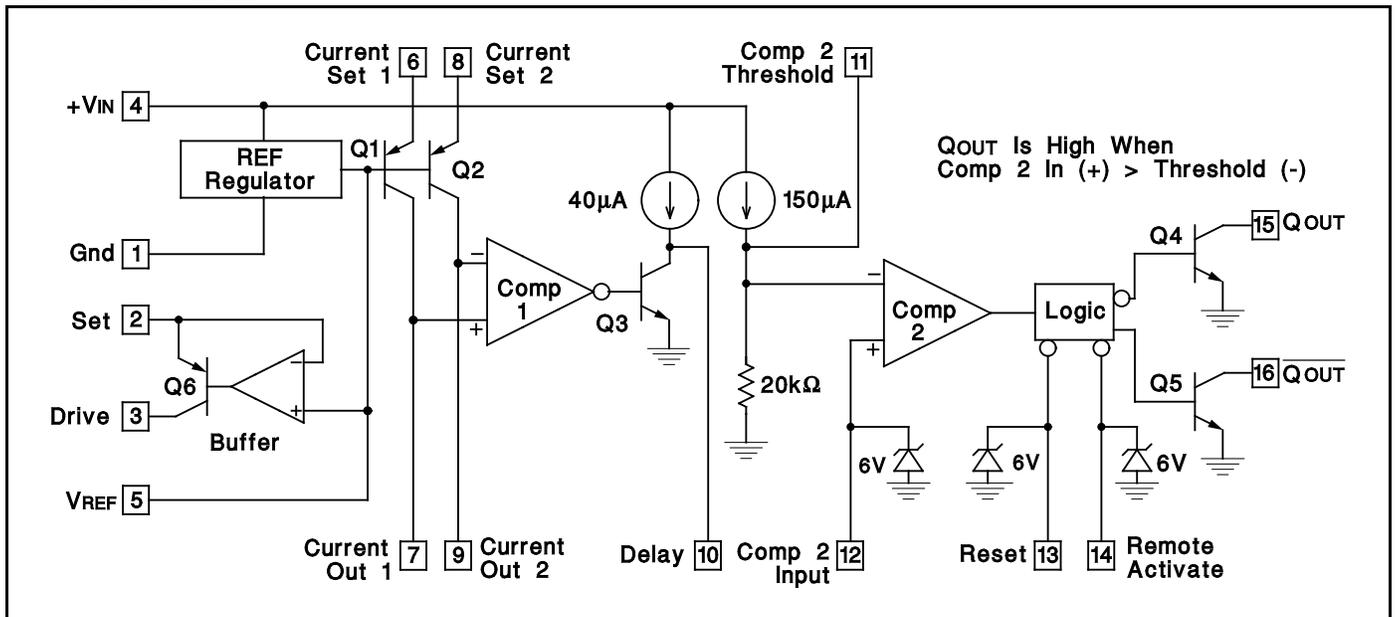
DESCRIPTION

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



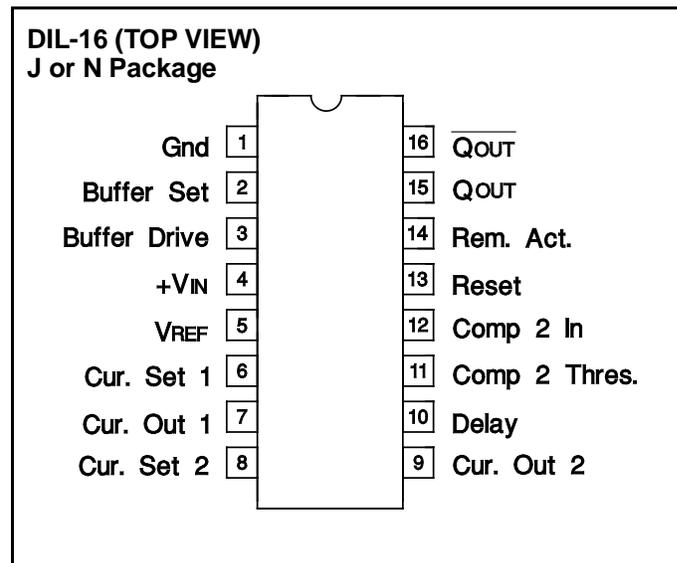
ABSOLUTE MAXIMUM RATINGS

Supply Voltage (+VIN)	40V
Output Current (each output)	50 mA
Buffer Power Source Current	200mA
Comparator 1 Inputs	-0.5V to VREF
Comparator 2 Inputs	0 to 5.5V
Remote Activation and Reset Inputs	0 to 5.5V
Power Dissipation at TA = 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

ELECTRICAL CHARACTERISTICS: Unless otherwise stated, these specifications apply for TA = 0°C to +70°C for the UC3704: VIH = 15V, TA = TJ.

PARAMETERS	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Power Inputs					
Supply Voltage Range		4.2		36	V
Supply Current	VIN = 36V		5	10	mA
Reference Section (with respect to VIN)					
VREF Value VIN - VREF	TJ = 25°C	2.1	2.2	2.3	V
VREF Temperature Coefficient	Note 1	-1	-2	-3	mV/°C
Line Regulation	ΔVIN = 4.2 to 25V		2	10	mV
Load Regulation	ΔIO = 0 to 4mA		2	10	mV
Short Circuit Current	VIN = 36V, VREF = VIN 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	RE6 = RE8 = 20kΩ		0	±1	μA
Comparator One					
Input Offset Voltage			±1	±4	mV
Input Bias Current			-100	-300	nA
Input Offset Current				±60	nA
CMRR	VCM = 0 to 12V	60	70		dB
Voltage gain	RL > 150kΩ	70	85		dB
Delay Current Source		34	40	52	μA
Output Rise Time	Overdrive = 10mV, CD = 15pF, TJ = 20°C		2		V/μs

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

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	$k\Omega$
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	$T_A = 25^\circ\text{C}$	0.8	1.2		V
Reset Threshold	$T_A = 25^\circ\text{C}$	0.8	1.2		V
Output Saturation	$I_{OUT} = 16\text{mA}$		0.2	0.5	V
	$I_{OUT} = 50\text{mA}$		0.7	2.0	V
Output Leakage	$V_{OUT} = 40\text{V}$		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 ($V_{IN} - V_S$)	$T_J = 25^\circ\text{C}$, $I_S = 100\text{mA}$	1.9	2.1	2.3	V
Drive Current	$T_J = 25^\circ\text{C}$, $R_S = 200\Omega$, $V_D = 0\text{V}$	90	100	120	mA

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

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

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 200 μA , and the common-mode input voltage of the comparator usable from ground to ($V_{IN} - 3\text{V}$), 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:

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

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.

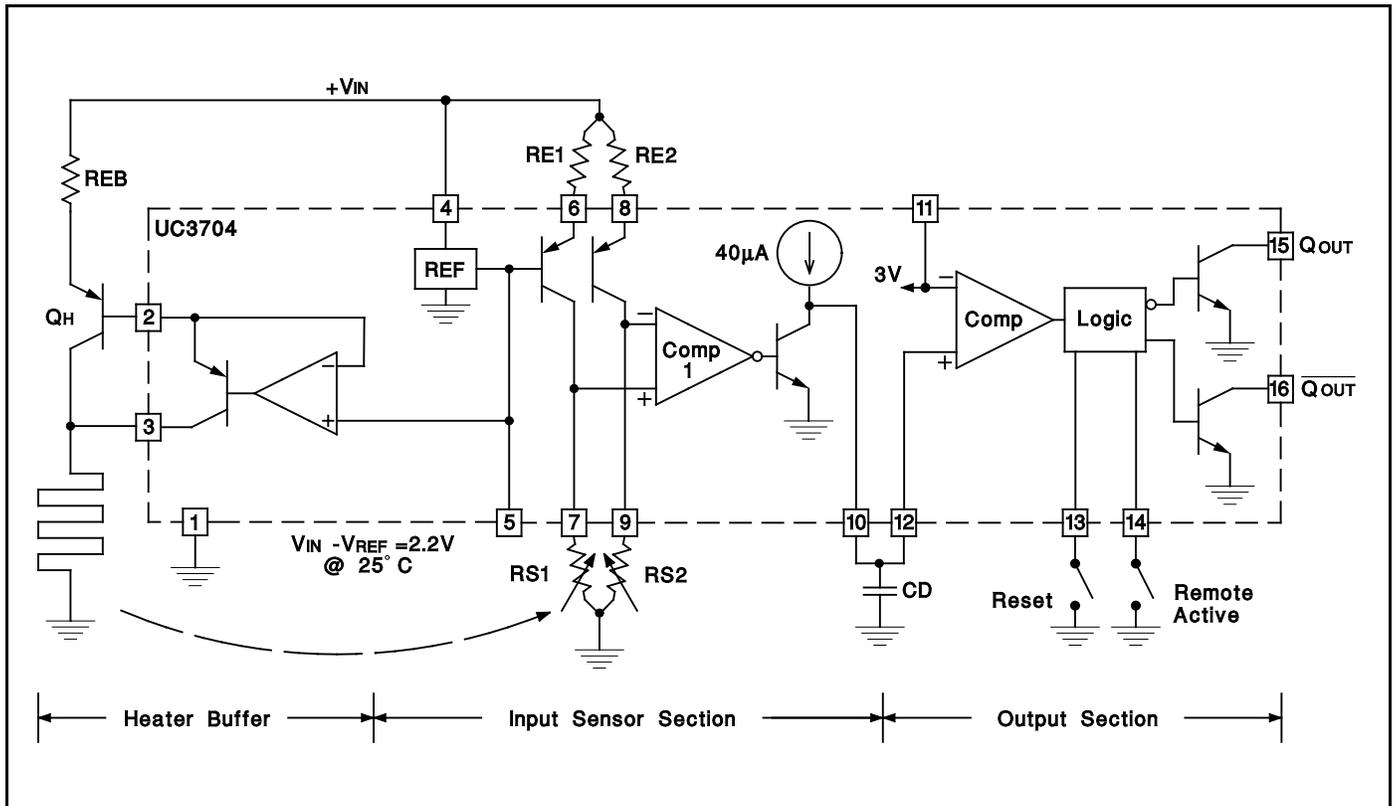
Pulling the Reset terminal low overrides the Remote Activate Pin releasing the latch.

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



PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
UC3704J	OBSOLETE		UTR			TBD	Call TI	Call TI
UC3704N	OBSOLETE		UTR			TBD	Call TI	Call TI

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Audio	www.ti.com/audio
Automotive	www.ti.com/automotive
Broadband	www.ti.com/broadband
Digital Control	www.ti.com/digitalcontrol
Medical	www.ti.com/medical
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
Security	www.ti.com/security
Telephony	www.ti.com/telephony
Video & Imaging	www.ti.com/video
Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2008, Texas Instruments Incorporated