HA16603P/FP

Contactless Switch

HITACHI

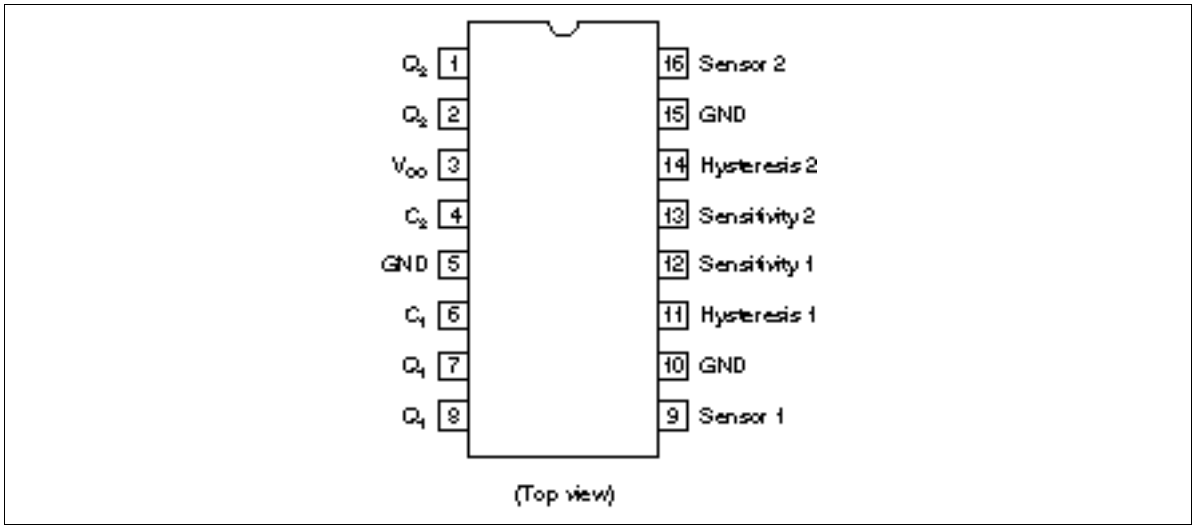
Description

The HA16603P is an IC for use with metal proximity switches. It can be used for the coin sensor circuit in vending machines and similar microprocessor sensors.

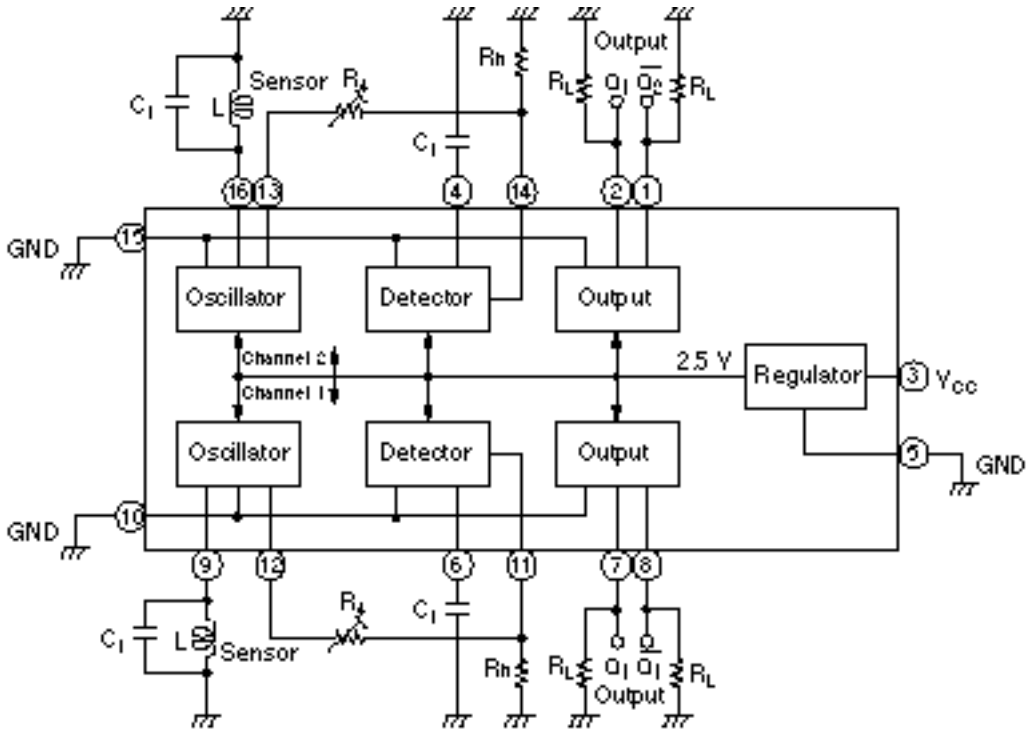
Features

- Two proximity switch channels
- The input and output pins are arranged in pairs for convenient printed circuit board mounting.
- Wide operating power-supply voltage range: 4.75 to 30 V
- Low power with a dissipation current of only 2.5 mA
- Normal and inverted outputs can be acquired at the same time.
- The outputs is available for current-source drive only since the internal circuits are NPN transistors with open emitter outputs.

Pin Arrangement



Block Diagram



Notes: R_A: Sensing distance adjustment resistor
Rh: Hysteresis resistor
R_L: Leakage bypass resistor
C_I: Detector integration capacitor
When a metallic object approaches the sensor coil L (sensor on), the outputs ⑦ and ② go to the high level and the outputs ① and ⑧ go to the low state.

Absolute Maximum Ratings (Ta = 25°C)

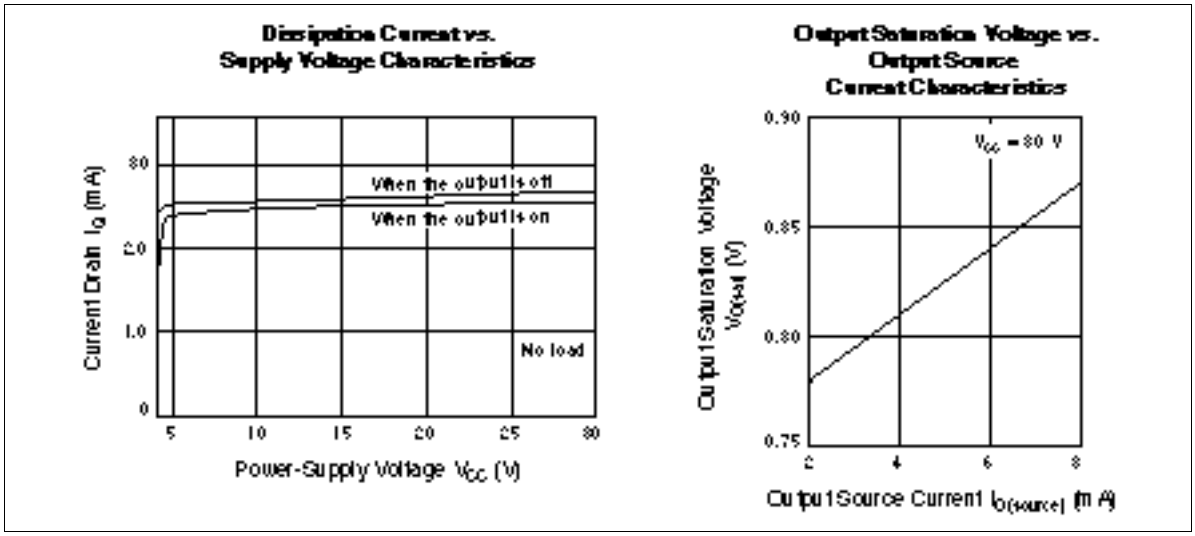
Item	Symbol	Rated Value	Unit
Operating power-supply voltage range	V_{CC}	4.75 to 30	V
Output voltage	Vout	0 to V_{CC}	V
Hysteresis pin voltage	V_{11}, V_{14}	0 to V_{CC}	V
Sensor pin voltage	V_9, V_{16}	–1.3 to +2.0	V
Sensitivity pin voltage	V_{12}, V_{13}	–0.65 to +2.0	V
Capacitor pin voltage	V_4, V_6	0 to +2.0	V
Output source current	Io(source)	–7 to 0	mA
Hysteresis pin sink current	I_{11}, $I_{14\ (sink)}$	0 to +1.0	mA
Sensitivity pin source current	I_{12}, $I_{13\ (source)}$	–5 to +0.1	mA
Sensor pin source current	I_9, $I_{16\ (source)}$	–1.0 to 0	mA
Capacitor pin sink current	I_4, $I_{6\ (sink)}$	0 to +5.0	mA
Allowable power dissipation*	P_T	625	mW
Capacitor pin source current	I_4, $I_{6\ (source)}$	–320 to 0	µA
Operating temperature	Topr	–25 to +85	°C
Storage temperature	Tstg	–40 to +125	°C

Note: When multiple maximum ratings apply to the same pin, the rating that corresponds to the smallest stress is the valid rating.

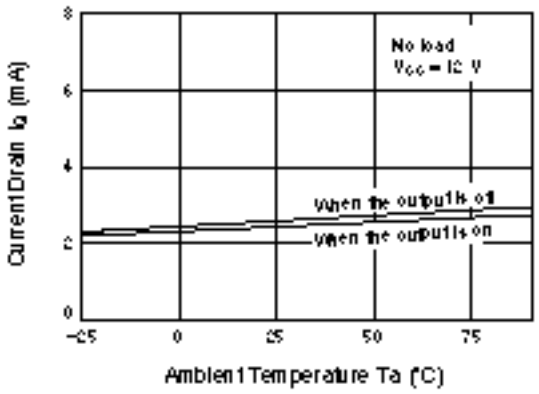
* See page 51.

Electrical Characteristics (V_{CC} = 24 V, Ta = 25°C)

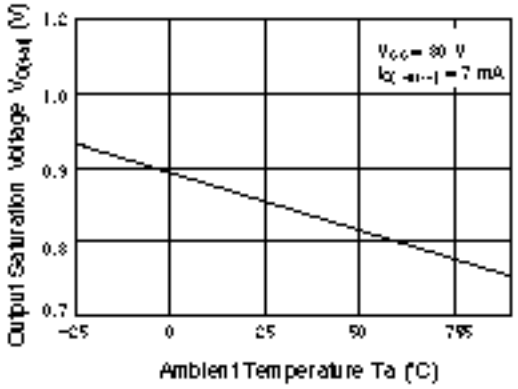
Item	Symbol	Min	Typ	Max	Unit	Test Condition	
Dissipation current	I_Q	—	2.5	6.0	mA	Sensor 1 and sensor 2: ground, V_{CC} = 30 V, sensitivity 1 and sensitivity 2: 10 k to ground	
Output saturation voltage	$V_{O(sat)}$	—	—	1.0	V	(V_{CC} – Vout) $I_{O(source)}$ = +7 mA	Ta = 25°C
		—	—	1.1	V		Ta = –25°C
Output leakage current	$I_{O(leak)}$	–600	—	—	nA	V_{CC} = 30 V	Ta = 25°C
		–40	—	—	µA		Ta = 85°C
Hysteresis pin internal resistance (on state)	r_{CS}	—	—	260		I_{11}, $I_{14\ (sink)}$ = 500 µA	
Hysteresis pin leakage current	I_{11}, $I_{14\ (leak)}$	—	—	1	µA	V_{CC} = 30 V	
Oscillator frequency	f_{OSC}	—	—	1,000	kHz		



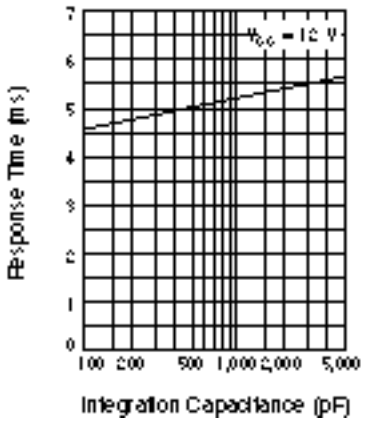
Dissipation Current vs. Ambient Temperature Characteristics



Output Saturation Voltage vs. Ambient Temperature Characteristics



Response Time vs. Integration Capacitor Capacitance Characteristics



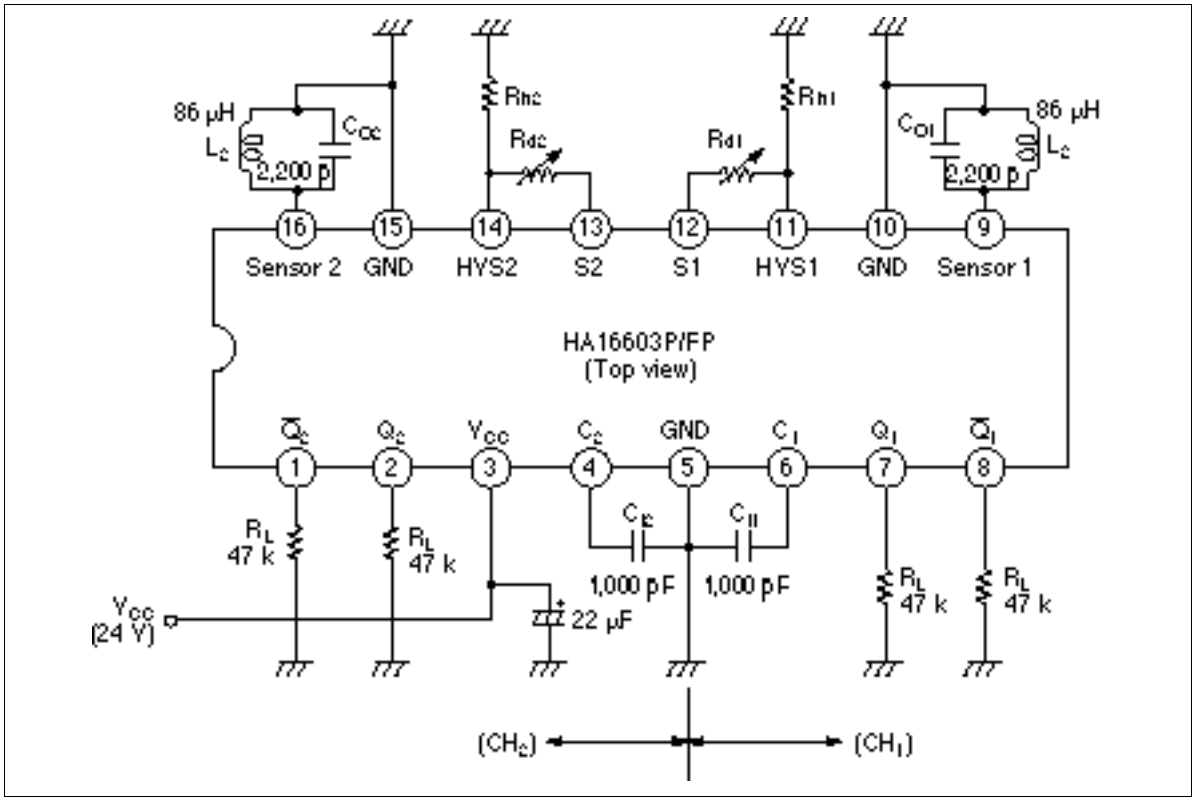
Notes

(1) An air-core coil must be used as the sensor coil.

(2) This IC has 3 ground pins. All three ground pins must be connected to ground, even if only one channel is used.

(3) If the sensitivity is set too high for a sensor coil with bad temperature characteristics, the operating temperature range may become narrow. The operating temperature range for the whole system, including the sensor coil, can be expanded by holding down the sensitivity.

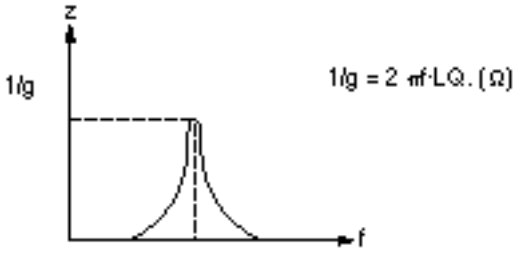
Sample Recommended Operating Circuit



The oscillator frequency is determined by the following formula.

$$f_{osc} = \frac{1}{2\pi\sqrt{LC_0}}$$

The tank circuit formed by L and C0 has characteristic impedance shown in the figure. The condition for oscillation for the HA16603P is Rd 1/g, and the condition for oscillation to stop is Rd > 1/g.



When Rd is connected to the hysteresis pin, (Rd + r_{cs} // Rh) 1/g is the condition for oscillation to start, and (Rd + Rh) > 1/g is the condition for oscillation to stop. Note that r_{cs} is the internal resistance of the hysteresis pin.

The relationship between oscillation occurring or not and the detection of a metallic object is as follows:

Oscillation occurs: When no metallic object is detected (i.e. the sensor coil and the metallic object are separated)

Oscillation stops: When a metallic object is detected (i.e. the metallic object is near the sensor coil)

Setting the Detection Distance

Since the detection distance depends on the Q of the sensor coil and the shape, surface area, thickness, and material of the metallic object, it can only be set by testing the completed system. Note that Rd sets the detection distance.