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# HA16603P/FP

Contactless Switch

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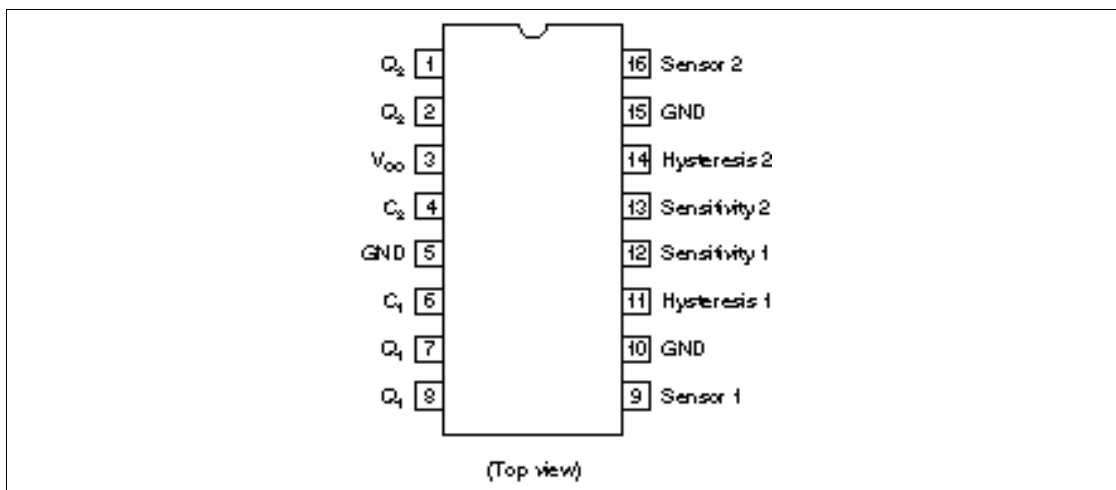
## Description

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

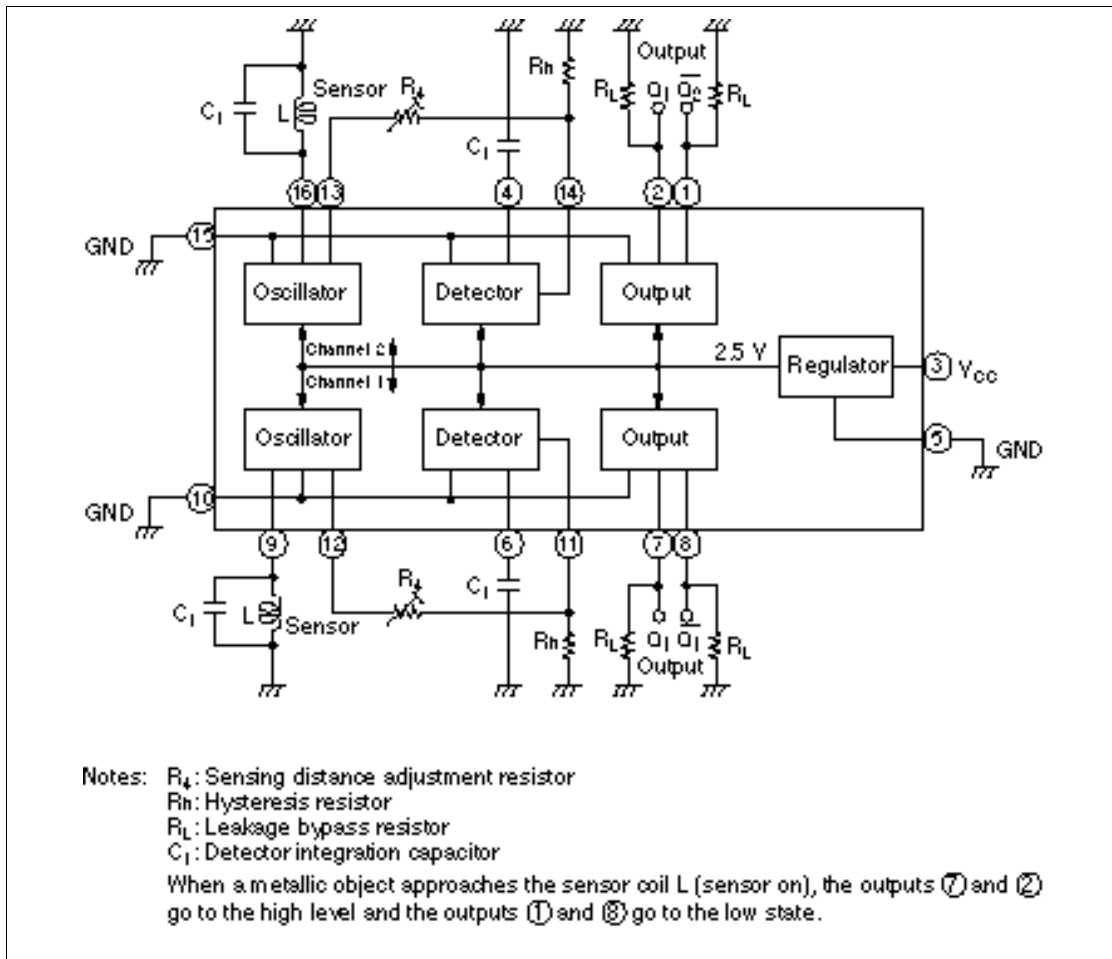
- Two proximity switch channels
- The input and output pins are arranged in pairs for convenient printed circuit board mounting.
- Wide operating power-supply voltage range: 4.75 to 30 V
- Low power with a dissipation current of only 2.5 mA
- Normal and inverted outputs can be acquired at the same time.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

## Pin Arrangement



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## Block Diagram



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### Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rated Value	Unit
Operating power-supply voltage range	V <sub>CC</sub>	4.75 to 30	V
Output voltage	V <sub>out</sub>	0 to V <sub>CC</sub>	V
Hysteresis pin voltage	V <sub>11</sub> , V <sub>14</sub>	0 to V <sub>CC</sub>	V
Sensor pin voltage	V <sub>9</sub> , V <sub>16</sub>	−1.3 to +2.0	V
Sensitivity pin voltage	V <sub>12</sub> , V <sub>13</sub>	−0.65 to +2.0	V
Capacitor pin voltage	V <sub>4</sub> , V <sub>6</sub>	0 to +2.0	V
Output source current	I <sub>o</sub> (source)	−7 to 0	mA
Hysteresis pin sink current	I <sub>11</sub> , I <sub>14</sub> (sink)	0 to +1.0	mA
Sensitivity pin source current	I <sub>12</sub> , I <sub>13</sub> (source)	−5 to +0.1	mA
Sensor pin source current	I <sub>9</sub> , I <sub>16</sub> (source)	−1.0 to 0	mA
Capacitor pin sink current	I <sub>4</sub> , I <sub>6</sub> (sink)	0 to +5.0	mA
Allowable power dissipation*	P <sub>T</sub>	625	mW
Capacitor pin source current	I <sub>4</sub> , I <sub>6</sub> (source)	−320 to 0	μA
Operating temperature	T <sub>opr</sub>	−25 to +85	°C
Storage temperature	T <sub>stg</sub>	−40 to +125	°C

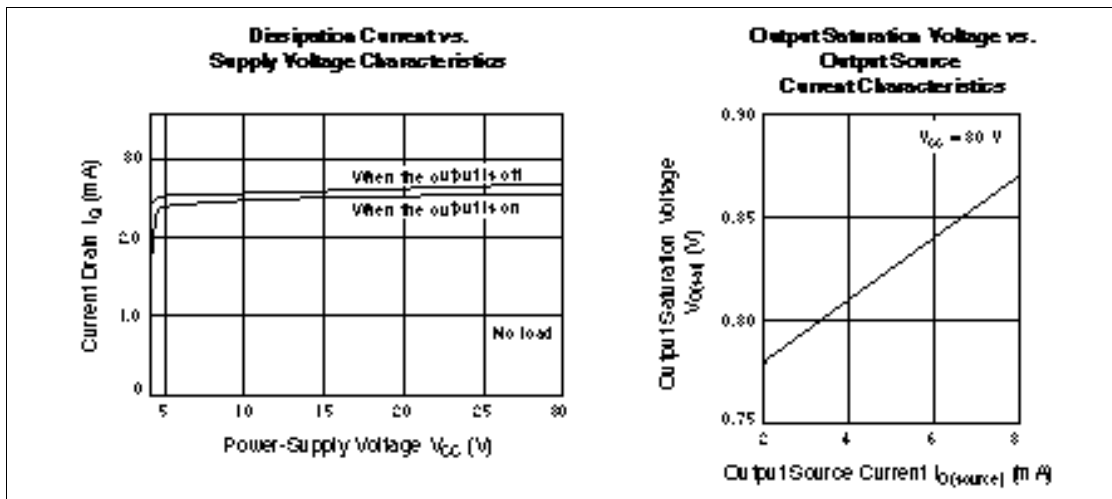
Note: When multiple maximum ratings apply to the same pin, the rating that corresponds to the smallest stress is the valid rating.

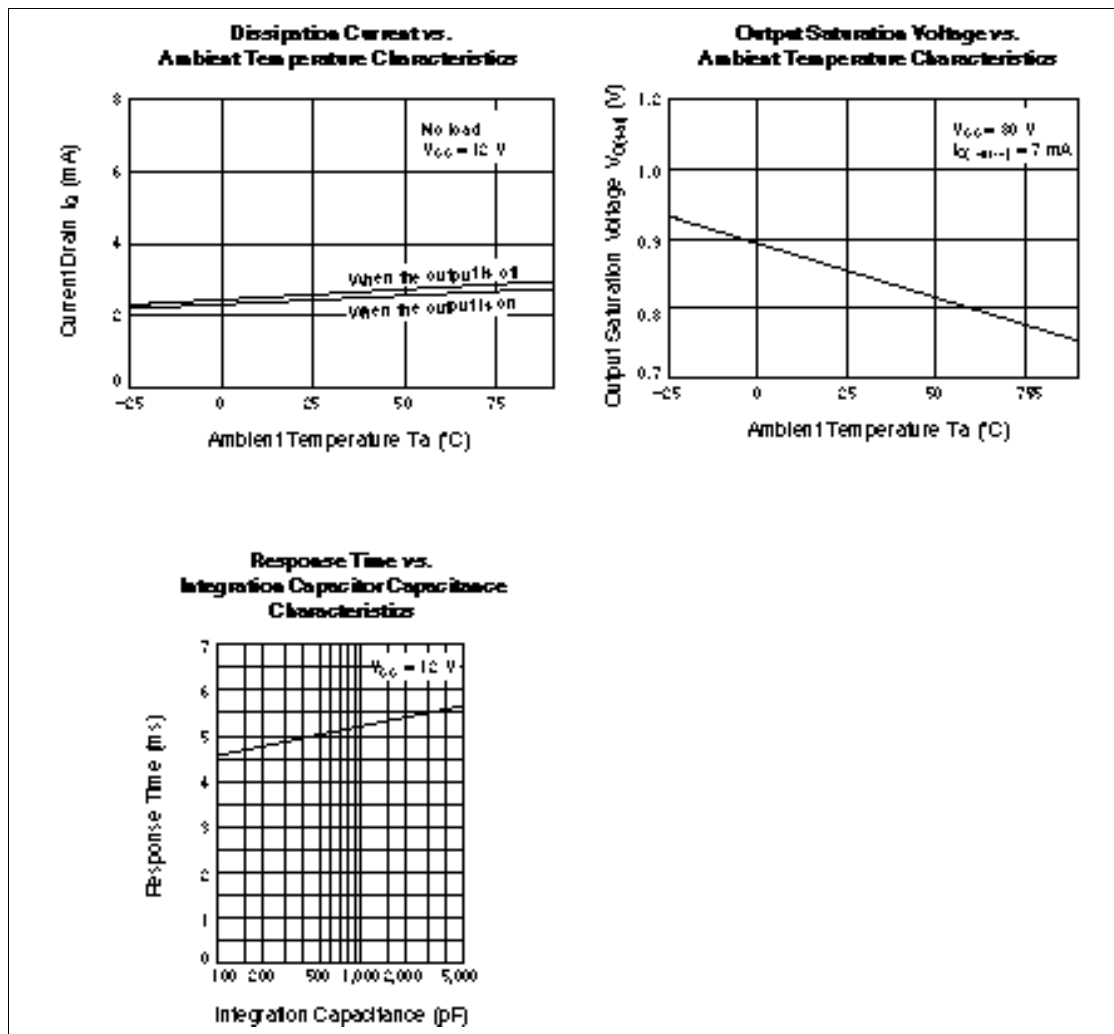
\* See page 51.

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**Electrical Characteristics** ( $V_{CC} = 24\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )

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

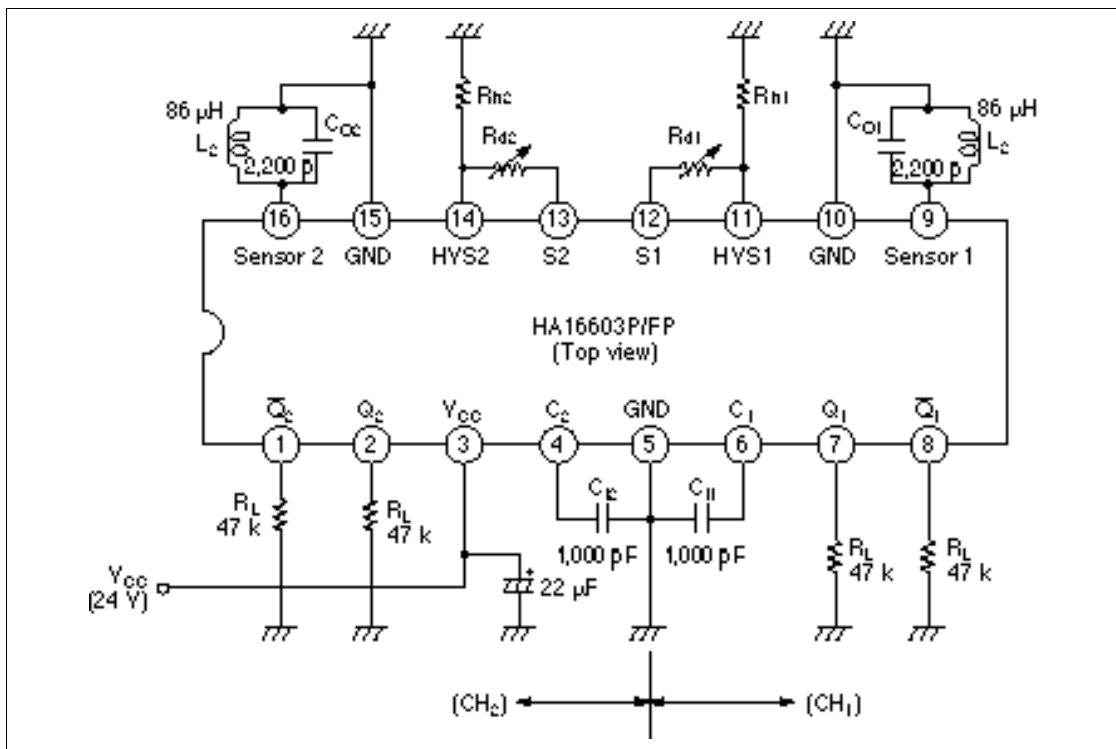




## Notes

- (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



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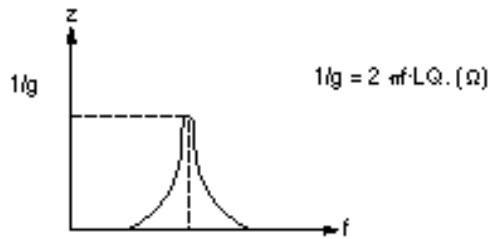
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The oscillator frequency is determined by the following formula.

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

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



When  $R_d$  is connected to the hysteresis pin,  $(R_d + r_{cs} // R_h) \leq 1/g$  is the condition for oscillation to start, and  $(R_d + R_h) > 1/g$  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  $R_d$  sets the detection distance.

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