Honeywell

Solid State Hall-effect Sensors

Adjustable Hall-Effect Under-speed Detectors

SS421 Series

FEATURES

- Wide temperature ranges for design flexibility
- Temperature compensated for consistent operation with low-cost magnets
- Bipolar operation for easy RPM counting using ring magnets
- Built-in timing circuit greatly simplifies and reduces the cost of PC board design
- Speed trip point adjustable with external resistor and capacitor

TYPICAL APPLICATIONS

- Under-speed detection for fans
- Conveyors
- Motor control
- Power-up fault failure filter in motor start-up

The SS421 Series Adjustable Hall-effect Under-speed Detectors are designed to monitor fan or motor performance. This temperature-compensated, Hall-effect IC contains a timing circuit and logic, that senses magnetic input frequency. The internal circuitry contains a timer so that one or two pulses at a slower repetition rate than the set point do not produce an unwanted output.

A small amount of hysteresis has been built into the output so that operation right at the set point does not result in a chattering output. The user simply provides an external resistor and capacitor combination to select the RPM trip point that will fit the particular application.

External components are used to set the frequency trip point and inertial delay time for output switching. The SS421L has an inverting output; the SS421H has a non-inverting output.

The small 4-pin package easily mounts on PC boards and flexible circuits. Built-in temperature compensation is optimized to match the temperature coefficient of low-cost magnets and track their performance over temperature.

The device will operate with supply voltages as low as 4.5 Vdc and as high as 16.0 Vdc. The output is an open-collector NPN capable of sinking 20 mA.

⚠WARNING

PERSONAL INJURY

- DO NOT USE these products as safety or emergency stop devices, or in any other application where failure of the product could result in personal injury.

Failure to comply with these instructions could result in death or serious injury.

⚠WARNING

MISUSE OF DOCUMENTATION

- The information presented in this product sheet is for reference only. Do not use this document as product installation information.
- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

Failure to comply with these instructions could result in death or serious injury.

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Figure 1. SS421H Timing Diagram
Td is the time delay after the pulses/min go below the trip point. Td is set by the external RC.
Tp is the time delay after the pulses/min go above the trip point. Tp is less than 20% of Td.

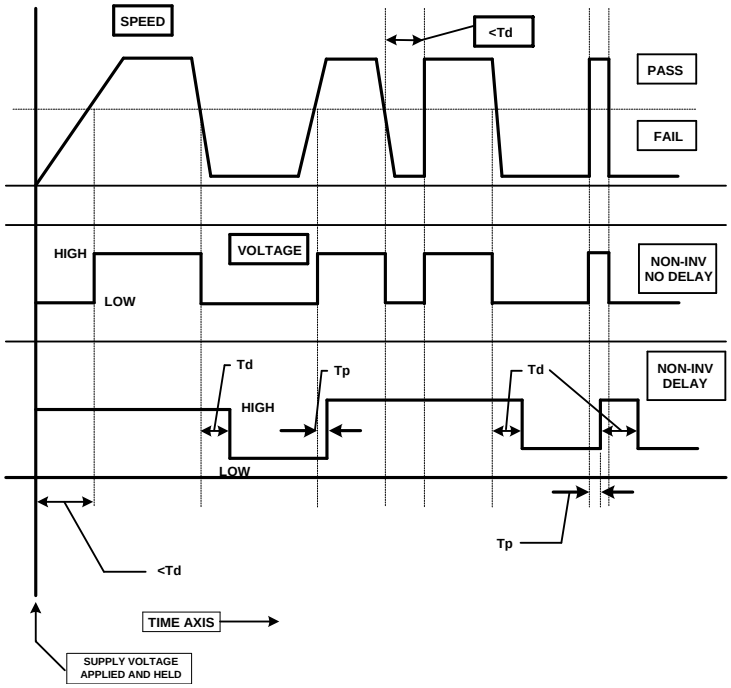

Figure 2. SS421L Timing Diagram
Td is the time delay after the pulses/min go below the trip point. Td is set by the external RC.
Tp is the time delay after the pulses/min go above the trip point. Tp is less than 20% of Td.

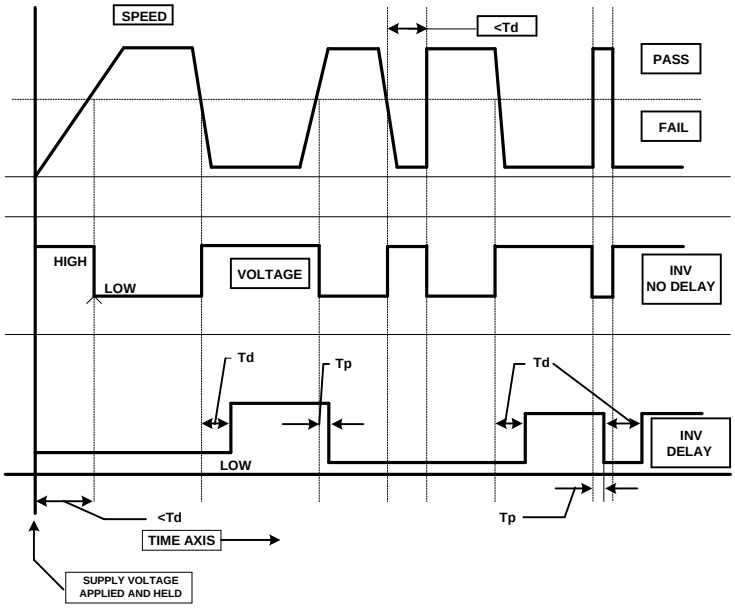

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Table 1. Timing Table

Frequency trip point: FTP = 60/**RC** ln[(Vr1-Ic**R**)/(Vr2-Ic**R**)

Inertial delay set time: DST = 7**RC** ln(Vr2/Vr1) + N * 60/FTP

[ln is the natural log]

Where nominal value of:

Vr1 = 2

Vr2 = 2Vr1 = 4 V

Ic – 196 µA

N = 12

R, **C** = external components

External components: **R** (Kohm) and **C** (µF)

Target Timings: Frequency trip point (RPM)/Inertial delay set time(s)#

R / C	1	1.2	1.5	1.8	2.2	2.7	3.3
39	3516 / 0.39	2930 / 0.47	2344 / 0.59	1954 / 0.71	1598 / 0.87		
43	3744 / 0.40	3120 / 0.48	2496 / 0.60	2080 / 0.72	1702 / 0.88		
47	3931 / 0.41	3276 / 0.49	2620 / 0.62	2184 / 0.74	1787 / 0.90		
51	4087 / 0.42	3406 / 0.51	2725 / 0.64	2271 / 0.76	1858 / 0.93		
56	4250 / 0.44	3542 / 0.53	2834 / 0.66	2361 / 0.79	1932 / 0.97		
62	4411 / 0.46	3676 / 0.56	2940 / 0.70	2450 / 0.84			
68	4542 / 0.49	3785 / 0.59	3028 / 0.73	2523 / 0.88			
75	4669 / 0.52	3890 / 0.62	3112 / 0.78	2594 / 0.93			
82	4773 / 0.55	3978 / 0.66	3182 / 0.82	2652 / 0.99			
91	4884 / 0.59	4070 / 0.71	3256 / 0.88				
100	4974 / 0.63	4145 / 0.76	3316 / 0.94				
110	5057 / 0.68	4214 / 0.81					
120	5126 / 0.72	4272 / 0.87					
130	5184 / 0.77	4320 / 0.92					
150	5277 / 0.86						1599 / 2.85
300	5579 / 1.58						1691 / 5.23
330						2077 / 4.67	1699 / 5.71
360						2085 / 5.06	1706 / 6.19
390						2092 / 5.45	1712 / 6.67
430					2577 / 4.87	2100 / 5.98	1718 / 7.30
470					2586 / 5.30	2107 / 6.50	1724 / 7.94
510				3169 / 4.68	2592 / 5.72	2112 / 7.02	1728 / 8.58
560				3177 / 5.12	2600 / 6.25	2118 / 7.68	1733 / 9.38
620			3823 / 4.70	3186 / 5.64	2607 / 6.89	2124 / 8.46	1738 / 10.34
680			3832 / 5.14	3193 / 6.16	2613 / 7.53	2129 / 9.25	1742 / 11.30
750			3840 / 5.65	3200 / 6.78	2618 / 8.28	2133 / 10.16	1745 / 12.42
820		4808 / 4.92	3847 / 6.16	3206 / 7.39	2623 / 9.03	2137 / 11.08	1749 / 13.54
910		4818 / 5.45	3854 / 6.81	3212 / 8.17	2628 / 9.99	2141 / 12.26	1752 / 14.98
1000	5790 / 4.98	4825 / 5.97	3860 / 7.46	3217 / 8.96	2632 / 10.95	2144 / 13.44	1755 / 16.42
1100	5798 / 5.46	4832 / 6.55	3865 / 8.19	3221 / 9.83	2636 / 12.02	2147 / 14.75	
1200	5805 / 5.95	4837 / 7.14	3870 / 8.92	3225 / 10.70	2639 / 13.08	2150 / 16.06	
1300	5811 / 6.43	4842 / 7.72	3874 / 9.65	3228 / 11.58	2641 / 14.15	2152 / 17.37	
1500	5820 / 7.40	4850 / 8.88	3880 / 11.10	3233 / 13.32	2645 / 16.28		
1600	5824 / 7.89	4853 / 9.46	3882 / 11.83	3235 / 14.20			
1800	5830 / 8.86	4858 / 10.63	3887 / 13.29	3239 / 15.94			
2000	5835 / 9.83	4862 / 11.79	3890 / 14.74	3242 / 17.69			
2200	5839 / 10.80	4866 / 12.96	3893 / 16.20				
2400	5842 / 11.77	4869 / 14.12					

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Table 2. Absolute Maximum Ratings[Note 1)]

Parameter	Min	Max	Unit	Conditions
Ambient temperature	-40 [-40]	125 [257]	°C [°F]	Storage, no power applied
Ambient temperature	-40 [-40]	105 [221]	°C [°F]	Operating, power applied
Supply voltage	-25	25	Vdc	-40 °C to 105 °C [-40 °F to 302 °F] ambient temperature
Voltage at output	-0.5	25	Vdc	Off condition of output over temperature
Open collector NPN	–	20	mA	Operated over temperature, current sinking output inverted or non-inverted

Notes:
1. Absolute maximum ratings are the extreme limits the device will withstand without damage to the device. However, the electrical and mechanical characteristics are not guaranteed as the maximum limits (above recommended operating conditions) are approached, nor will the device necessarily operate at absolute maximum ratings.

Table 3. Electrical Characteristics[Note 1)] (Required -25 °C to 105 °C [-13 °F to 221 °F] ambient)

Parameter	Min	Max	Unit	Conditions
Supply voltage (Vs)	4.5	16.0	Vdc	–
Supply current (Is)	–	15.0 15.0	mA mA	Output released, Vs = 16 V, T_J = 25 °C [77 °F]
Supply current (Is)	–	15.0 15.0	mA mA	Output operated, Vs = 16 V, T_J = 25 °C [77 °F]
Output voltage	–	0.4	Vdc	Sinking 15 mA, Vsat
Output leakage current	–	10.0	µA	Output at 25 V
Rise time (10% to 90%)	–	1.5	µs	Vs = 12 V, R = 800 ohms, C = 50 pf
Fall time (90% to 10%)	–	1.5	µs	Vs = 12 V, R = 800 ohms, C = 50 pf

Notes:
1. Over operating temperature and voltage range unless otherwise noted.

Table 4. Magnetic Characteristics[Note 1)] (Required -25 °C to 105 °C [-13 °F to 221 °F] ambient)

Parameter	Min	Max	Unit	Conditions
Operate point	–	250	G	Ta = 25 °C [77 °F], Note 2
Operate point	–	250	G	25 °C to 105 °CV [77 °F to 221 °FV]
Release point	-250	–	G	Ta = 25 °C [77 °F]
Release point	-250			-25 °C to 105 °C [-13 °F to 221 °F], Note 3
Differential	50	–	G	Operate minus release

Notes:
1. Over operating temperature and voltage range unless otherwise noted.
2. Operate point is defined as the gauss level above which the internal circuitry will always be indicating the presence of a south pole at the IC surface.
3. Release point is defined as the gauss level below which the internal circuitry will always be indication the presence of a north pole at the IC surface.

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Table 5. Timing Characteristics[Note 1] (Required -25 °C to 105 °C [-13 °F to 221 °F] ambient)

Parameter	Min	Max	Unit	Conditions
Trip point range	1800	5200	PPM	Ta = 25 °C [77 °F], Note 2
Trip point tolerance	-16.0	16.0	%	Variation from calculated value, Note 3
Trip point delay and power up delay				
Delayed version	5.0	16.0	sec	Ta = 25 °C [77 °F], 1800 to 5200 PPM
Non-delayed version		1.2	sec	Ta = +25 °C [77 °F], 1800 to 5200 PPM, Note 4
Delay set time tolerance				% of delay set time (whichever is smaller of the two sets)
	-40	40	%	
	-4.0	4.0	sec	
Passing delay fail to pass condition	–	20	%	% of delay set time, Note 5
External capacitor leakage coefficient	–	0.05	–	Note 6

Notes:
1. Over operating temperature and voltage range unless otherwise noted. Does not include R and C shifts over temperature.
2. Trip point is the frequency in PPM (pulses per minute) that causes the output to change state. An inverted output is low when the speed is greater than the trip point.
3. This is the accuracy required from unit to unit and includes R and C each varying ± 5% over speed, supply voltage, and temperature.
4. Trip point delay is the delay in output response to an input frequency below the trip point. The time delay is determined by the value of the external resistor and capacitor. Delayed version powers up in the passing condition.
5. Passing delay tolerance is based on delay set time. Its tolerance is proportional to delay set time tolerance.
6. Capacitor leakage coefficient is used to calculate leakage current in the following formula: leakage current = leakage coefficient x capacitance x capacitor voltage.

Table 6. Latch Characteristics[Note 1] (Required -25 °C to 105 °C [-13 °F to 221 °F] ambient)

Parameter	Min	Max	Unit	Conditions
Latch voltage	3.5	4.5	V	At VS = 5.0, Note 2
	2.0	4.5	V	
Latch current	–	1.0	mA	Note 3 (SS421L only)

Notes:
1. Over operating temperature and voltage range unless otherwise noted. External components must be connected between the output and the program/oscillator pin.
2. The open collector output can be used to drive external circuitry that applies a latching voltage to the program/oscillator pin to latch the IC output in the fail state. This latch mode is to be used only on products with delay set times greater than five seconds and with inverted output version of the SS421L.
3. Latching current is the sourcing current required of the applied external voltage to maintain the latch.

Table 7. External R and C Characteristics[Note 1] (Required -25 °C to 105 °C [-13 °F to 221 °F] ambient)

Parameter	Min	Max	Unit	Conditions
External resistor	–	±5	%	Directly related to trip accuracy
External capacitor	–	±5	%	Directly related to trip accuracy
External capacitor leakage coefficient	–	0.05	–	Note 2

Notes:
1. Over operating temperature and voltage range unless otherwise noted.
2. Leakage coefficient is the external capacitor leakage current coefficient such that leakage current = leakage coefficient x capacitance x capacitor voltage.

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Solid State Hall-effect Sensors

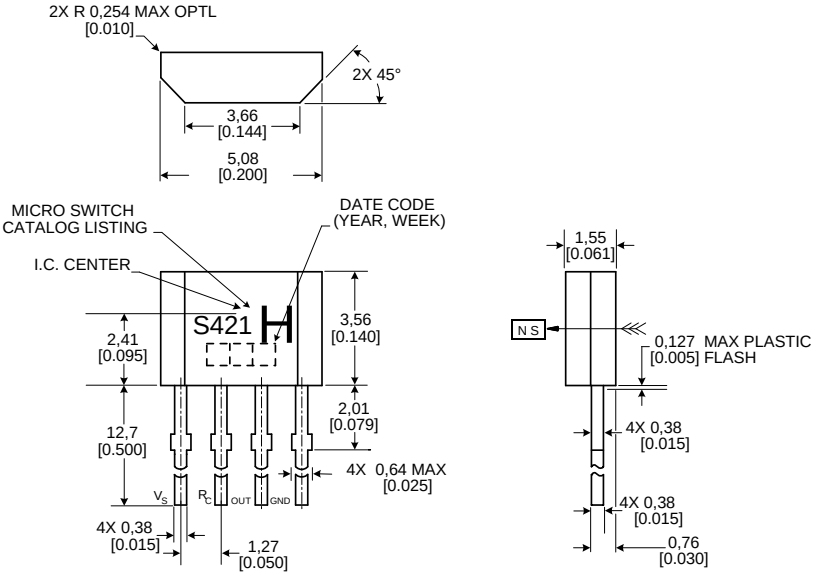
Adjustable Hall-Effect Under-speed Detectors

SS421 Series

ORDER GUIDE

Catalog Listing	Description
SS421L	Adjustable Hall-effect Under-speed Detector, Low (Speed > set point)
SS421H	Adjustable Hall-effect Under-speed Detector, High (Speed > set point)

Figure 3. SS421L/SS421H Series Mounting Dimensions mm/in
(for reference only)



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