Honeywell

Honeywell Sensing and Control

SS421H

Actual product appearance may vary.

SS421H Adjustable Hall-effect Underspeed Detector (Active - High); SIP-4 radial lead IC package

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

Potential Applications

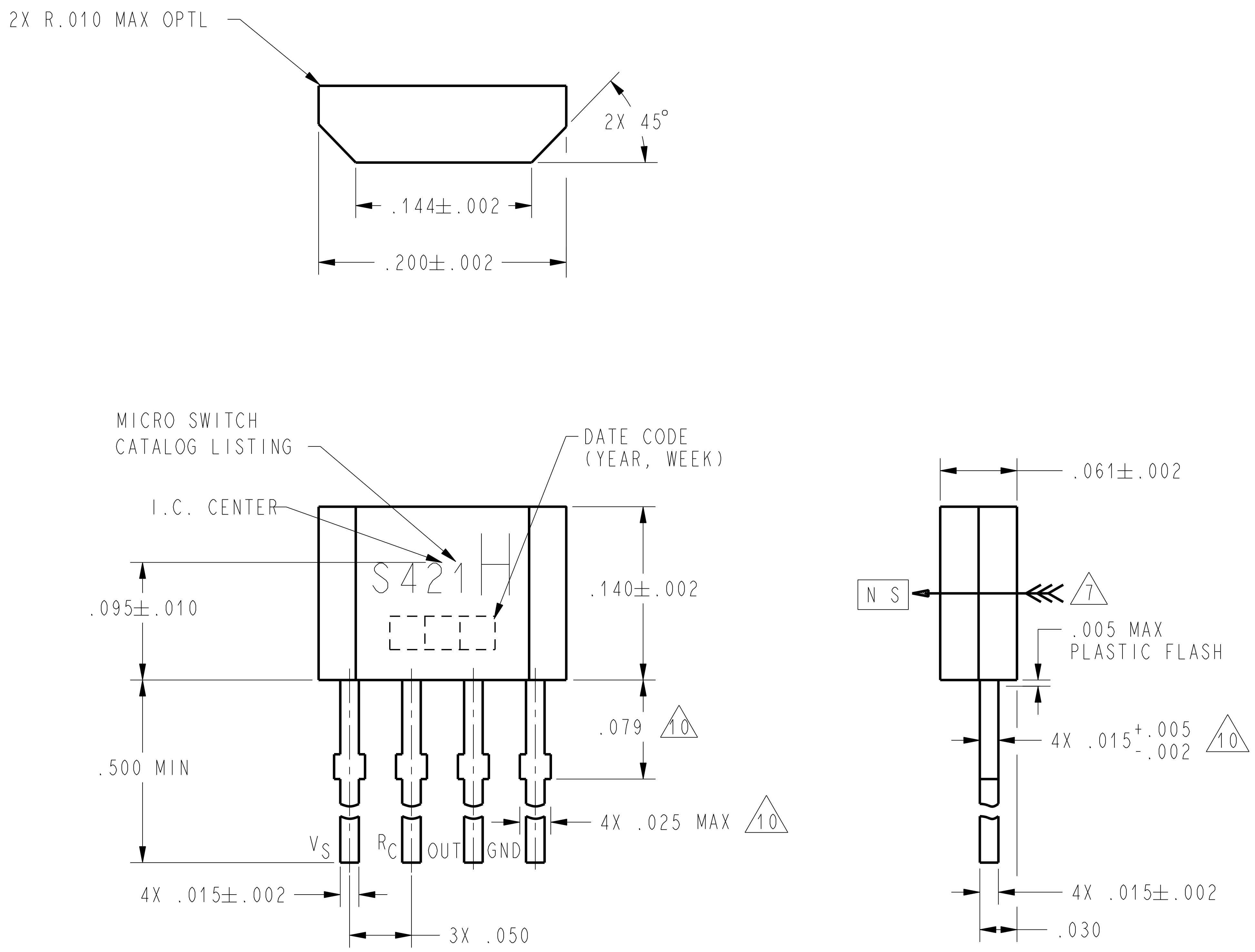
- Under-speed detection for fans
- Conveyors
- Motor control
- Power-up fault failure filter in motor start-up

Description

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.

Product Specifications	
Product Type	Hall-Effect Under-speed Detector IC
Package Style	Radial Lead IC
Supply Voltage	4.5 Vdc to 16 Vdc
Output Type	Sink
Termination Type	PC Board
Magnetic Actuation Type	Bipolar
Operating Temperature Range	-40 °C to 105 °C [-40 °F to 221 °F]
Storage Temperature	-40 °C to 125 °C [-40 °F to 257°F]
Output Voltage	0.4 Vdc max.
Switching Time Rise (10 % to 90 %)	1.5 µs max.
Switching Time Fall (90 % to 10 %)	1.5 µs max.
Output Voltage Span (min.)	0.4 Vdc
Operate Point	250 G
Release Point	-250 G
Availability	Global
Supply Current (max. @ 25 °C)	15 mA
Output Current (max.)	20.0 mA
Operate Point @ 25 °C	25.0 mT [250 G] max.
Release Point @ 25 °C	-25.0 mT [-250 G] min.
Leakage Current max.	10 µA
Differential	5.0 mT [50 G] min.
Series Name	SS421
Supply Current (typ. @ 25 °C)	15 mA

HIGH WHEN FREQUENCY IS > SET POINT



1. ABSOLUTE MAXIMUM RATINGS 9
(Circuit function is not guaranteed. If exceeded, permanent damage may result)

ITEM	PARAMETER	MIN	MAX	UNIT	CONDITIONS
1.1	AMBIENT TEMPERATURE	-40	+125	°C	Storage, no power applied
1.2	AMBIENT TEMPERATURE	-40	+105	°C	Operating, power applied
1.3	SUPPLY VOLTAGE	-25	+25	VDC	-40°C TO +105°C ambient temperature
1.4	VOLTAGE AT OUTPUT	-0.5	+25	VDC	off condition of output over temperature
1.5	OPEN COLLECTOR NPN		+20	mA	Operated over temperature, Current sinking output inverted or non-inverted

2. ELECTRICAL CHARACTERISTICS
(over operating temperature and voltage range unless otherwise noted)
REQUIRED -25°C TO +105°C AMBIENT

ITEM	PARAMETER	MIN	MAX	UNIT	CONDITIONS
2.1	SUPPLY VOLTAGE (Vs)	4.5	16	VDC	
2.2	SUPPLY CURRENT (Is)		15 15	mA mA	Output released, Vs=16V TJ=+25°C
2.3	SUPPLY CURRENT (Is)		15 15	mA mA	Output operated, Vs=16V TJ=+25°C
2.4	OUTPUT VOLTAGE		0.4	VDC	Sinking 15mA, Vsat
2.5	OUTPUT LEAKAGE CURRENT		10	uA	Output at 25V
2.6	RISE TIME (10% TO 90%)		1.5	uS	Vs=12V, R=800ohms, C=50pf
2.7	FALL TIME (90% TO 10%)		1.5	uS	Vs=12V, R=800ohms, C=50pf

3. MAGNETIC CHARACTERISTICS 8
(over operating temperature and voltage range unless otherwise noted)
REQUIRED -25°C TO +105°C AMBIENT

ITEM	PARAMETER	MIN	MAX	UNIT	CONDITIONS
3.1	OPERATE POINT		250	G	Ta=+25°C (See note 3.1)
3.2	OPERATE POINT		250	G	-25°C TO +105°C (See note 3.1)
3.3	RELEASE POINT RELEASE POINT	-250 -250		G G	Ta=+25°C -25°C TO +105°C (See note 3.2)
3.4	DIFFERENTIAL	50		G	Operate minus release

Frequency Trip Point (FTP)(RPM)

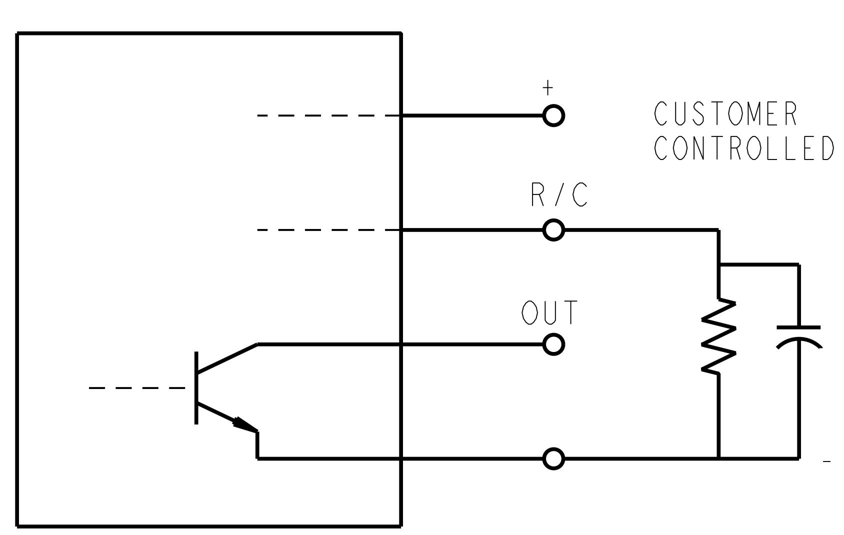
$$FTP = \frac{60}{RC \log\left[\frac{Vr1 - IcR}{Vr2 - IcR}\right]}$$

Delay Time (DST) (Seconds)

$$DST = 7RC \log\left[\frac{Vr2}{Vr1}\right] + \left[\frac{720}{FTP}\right]$$

WHERE,
R,C ARE EXTERNAL COMPONENTS
Vr1=2 VOLTS Vr2=4 VOLTS
Ic=196 µA
LOG IS NATURAL LOG

BLOCK DIAGRAM



NOTES

7. THE MAGNETIC FLUX USED TO OPERATE THE SWITCH MUST BE IN THE DIRECTION AND LOCATION SHOWN (THIS ASSUMES THE CONVENTION THAT THE DIRECTION OF THE EXTERNAL FLUX OF A MAGNET IS FROM THE NORTH TO THE SOUTH POLE OF THE MAGNET)
8. THE MAGNETIC FIELD STRENGTH (GAUSS) REQUIRED TO CAUSE THE SWITCH TO CHANGE STATE (OPERATE AND RELEASE) WILL BE AS SPECIFIED IN THE MAGNETIC CHARACTERISTICS. TO TEST THE SWITCH AGAINST THE SPECIFIED MAGNETIC CHARACTERISTICS THE SWITCH MUST BE PLACED IN A UNIFORM MAGNETIC FIELD
9. ABSOLUTE MAXIMUM RATINGS ARE THE EXTREME LIMITS THAT THE DEVICE WILL WITHSTAND WITHOUT DAMAGE TO THE DEVICE. HOWEVER, THE ELECTRICAL AND MAGNETIC CHARACTERISTICS ARE NOT GUARANTEED AS THE MAXIMUM LIMITS (ABOVE RECOMMENDED OPERATING CONDITIONS) ARE APPROACHED NOR WILL THE DEVICE NECESSARILY OPERATE AT ABSOLUTE MAXIMUM RATING
10. DIMENSIONS NOTED ARE DUE TO TIE BAR REMOVAL AND ARE VALID ONLY IN .079 DIMENSION. BURRS EXTEND BACK FROM FRONT SURFACE ONLY

THIRD ANGLE PROJECTION
SCALE 10:1
DO NOT SCALE PRINT

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE

ONE PLACE	(.0)	±.030
TWO PLACES	(.00)	±.015
THREE PLACES	(.000)	±.005
ANGLES		±2°

WEIGHT

MICRO SWITCH a Honeywell Division
FED. MFG. CODE 91929

SOLID STATE SWITCH

CATALOG LISTING SS421H

ANSI Y14.5M-1982 APPLIES

SS421H | DRAWING NUMBER | PAGE 1 OF 3 | RELEASE NO. PR-21852 | REPLACES X99395-SS | ISSUE 6
REVISIONS: A 0000297 CSL 14 MAY 03
DRAWN C S L 14 MAY 03 | CHECK | SAV 14 MAY 03 | CHECK | PTC/CAD 2D

4. TIMING CHARACTERISTICS
(over operating temperature and voltage range unless otherwise noted. Does not include R & C shifts over temperature)
REQUIRED -25°C TO +105°C AMBIENT

ITEM	PARAMETER	MIN	MAX	UNIT	CONDITIONS
4.1	TRIP POINT RANGE	1800	5200	PPM	Ta = 25° C (See note 4.1)
4.2	TRIP POINT TOLERANCE	-16.0	16.0	%	Variation from calculated value (See note 4.2)
4.3	TRIP POINT DELAY & POWER UP DELAY				
	DELAYED VERSION	5.0	16.0	SEC	Ta = 25°C, 1800 TO 5200 PPM
	NON-DELAYED VERSION		1.2	SEC	Ta = 25°C, 1800 TO 5200 PPM (See note 4.3)
4.4	DELAY SET TIME TOLERANCE THE SMALLER OF 4.4.1 & 4.4.2				
4.4.1		-40	+40	%	% of delay set time
4.4.2		-4.0	4.0	SEC	
4.5	PASSING DELAY FAIL TO PASS CONDITION		20	%	% of delay set time (See note 4.5)
4.6	EXTERNAL CAPACITOR LEAKAGE COEFFICIENT		0.05		(See note 4.6)

5. LATCH CHARACTERISTICS
(over operating temperature and voltage range unless otherwise noted. External components must be connected between the output and the program/oscillator pin)
REQUIRED -25°C TO +105°C AMBIENT

ITEM	PARAMETER	MIN	MAX	UNIT	CONDITIONS#
5.1	LATCH VOLTAGE				(See note 5.1)
5.11		3.5	4.5	V	
5.12		2.0	4.5	V	at VS = 5.0
5.2	LATCH CURRENT NOT APPLICABLE ON THIS NON-INVERTED DEVICE				

6. EXTERNAL R&C CHARACTERISTICS
(over operating temperature and voltage range unless otherwise noted)
REQUIRED -25°C TO +105°C AMBIENT

ITEM	PARAMETER	MIN	MAX	UNIT	CONDITIONS
6.1	EXTERNAL RESISTOR		±5	%	Directly related to 4.2 Trip Accuracy
6.2	EXTERNAL CAPACITOR		±5	%	Directly related to 4.2 Trip Accuracy
6.3	EXTERNAL CAPACITOR LEAKAGE COEFFIECENT		0.05		(See note 6.3)

3.1 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.

3.2 Release point is defined as the gauss level below which the internal circuitry will always be indicating the presence of a north pole at the IC surface.

4.1 Trip point is the frequency in PPM (pulses per minute) that causes the output to change state. A non-inverted output is high when speed is greater than the the trip point. For example, a 2 pole magnet translates to 1 pulse/revolution while the 4 pole magnet translates into 2 pulses/revolution.

The trip point is externally adjustable by varying the value of R and C. Maximum required value of the external capacitor is 3.3 uF.

4.2 This is the accuracy required from unit to unit and includes R and C each varying ±5%, over speed, supply voltage, and temperature.

4.3 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.

4.5 Passing delay tolerance is based on delay set time, its' tolerance is proportional to delay set time tolerance.

4.6 Capacitor leakage coefficient is used to calculate leakage current in the following formula:

Leakage Current = Leakage Coefficient x Capacitance x Capacitor Voltage
where capacitance is value of the external capacitor.

Capacitor Voltage is the actual variable voltage across the capacitor in operation.

5.1 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 5 seconds and with inverted output version of the SS421H. Va = externally applied voltage on the RC pin. (Not applicable on this non-inverted device)

5.2 Latching current is the sourcing current required of the applied external voltage to maintain the latch. (Not applicable on this non-inverted device)

6.3 Leakage coefficient is the external capacitor leakage current coefficient such that:

Leakage Current = Leakage Coefficient x Capacitance x Capacitor Voltage.
For example: Leakage Coefficient = 0.05; Capacitance = 3.3 uF; Capacitor Voltage at 3V; DC leakage current 0.49 uA.

MICRO SWITCH a Honeywell Division
FED. MFG. CODE 91929

SOLID STATE SWITCH

CATALOG LISTING
SS421H

ANSI Y14.5M-1982 APPLIES

THIRD ANGLE PROJECTION
SCALE NONE
DO NOT SCALE PRINT
UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
ONE PLACE (.0) ± .030
TWO PLACES (.00) ±.015
THREE PLACES (.000) ± .005
ANGLES ± 2°
WEIGHT

TIMING TABLE

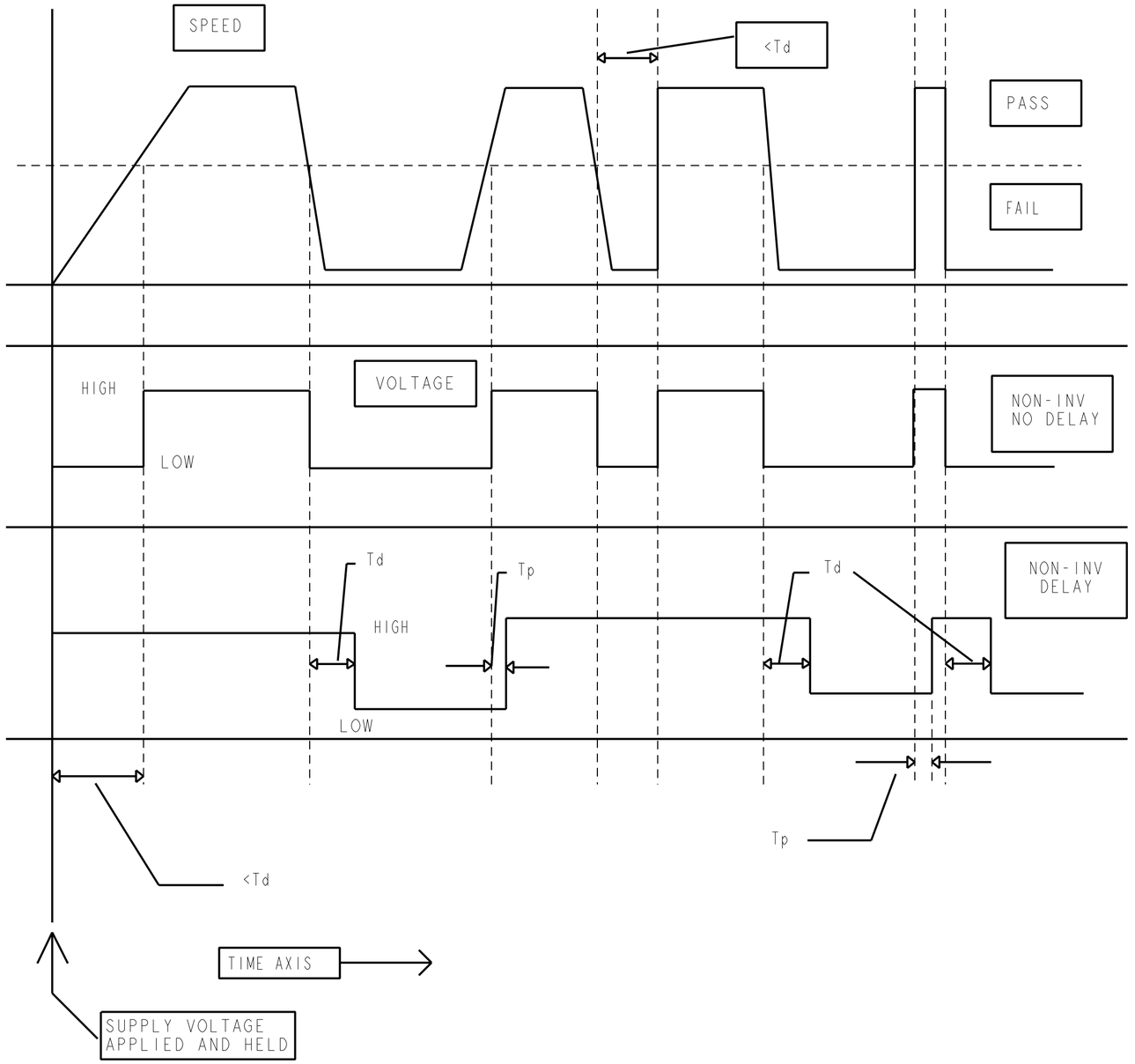
FREQUENCY TRIP POINT FTP = 60/(RCln((Vr1-IcR)/(Vr2-IcR)))
INERTIAL DELAY SET TIME DST = 7RCln(Vr2/Vr1)+N*60/FTP
ln is the natural log

WHERE NOMINAL VALUE OF:

Vr1 = 2V
Vr2 = 2Vr1=4V
Ic = 196uA
N = 12
R,C = exterior components

External components: R (Kohm) and C (uF)
Target Timings: Frequency Trip Point (PPM)/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						1681/4.75
300	5315/0.91						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					



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.

ANSI Y14.5M-1982 APPLIES

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SOLID STATE SWITCH

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PTC/CAD 2D
DRAWN C S L 14 MAY 03
CHECK
SAV 14 MAY 03
CHECK
CHECK
ISSUE 6
DRAWING NUMBER
RELEASE NO. PR-21852
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REPLACES X99395-SS

REVISIONS
A 0000297 C S L 14 MAY 03