Electronic Ignition Control Circuit

Description

The LD3335 (analog MC79076), in conjunction with an appropriate Power Darlington Transistor, provides an economical solution for automotive ignition applications. The LD3335offers optimum performance by providing closed loop operation of the Power Darlington in controlling the ignition coil current.

Features

- Hall or Variable Reluctance Sensor Input
- Ignition Coil Voltage Internally Limited to 375 V
- Coil Current Limiting to 7.5 A
- Output On–Time (Dwell) Control
- Dwell Feedback Control to Sense Coil Variation
- Two arrangement of pin

Ordering Information

Package	Remarks
SOP16L(W)	Tubed, Reeled, Pb-free

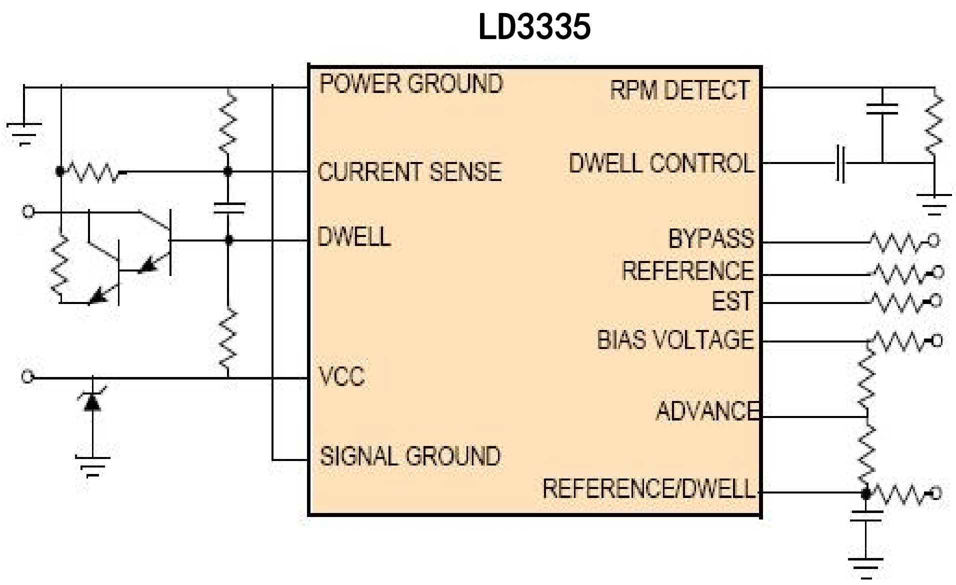


Figure1. LD3335 Simplified Application Diagram

Internal Block Diagram

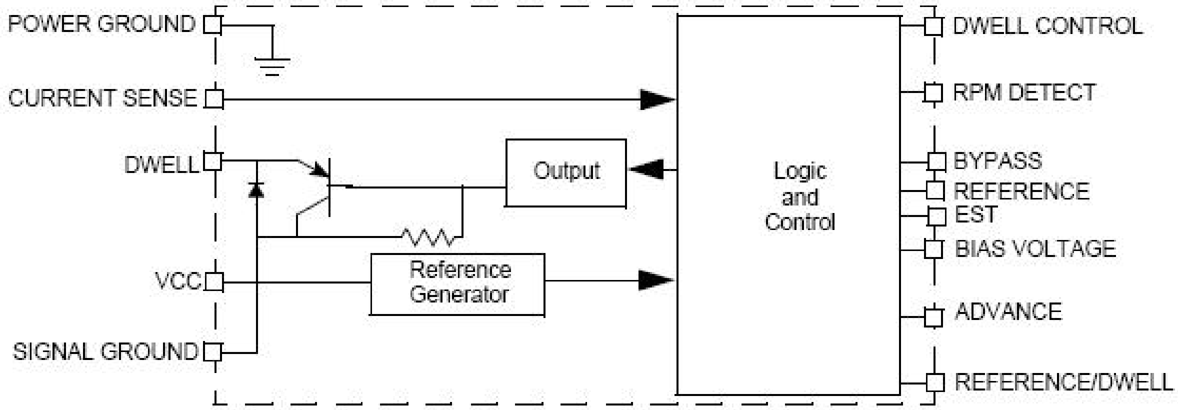


Figure2. LD3335 Simplified Internal Block Diagram

Pin Connections

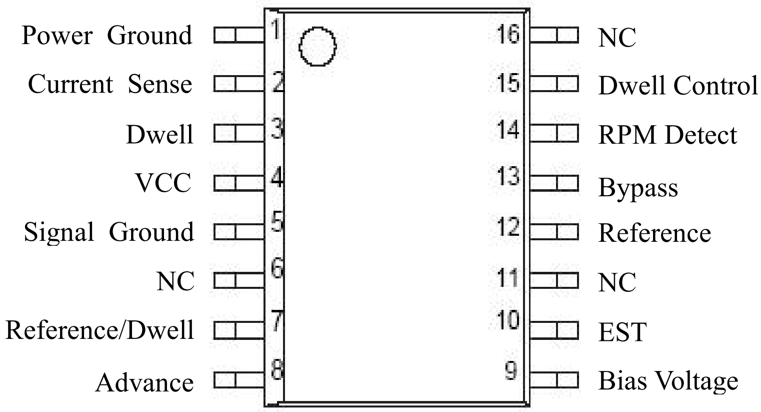


Figure3. LD3335 Pin Connections

Electrical Characteristics

Table 1. Maximum Ratings

All voltages are with respect to ground unless otherwise noted. Exceeding these ratings may cause a malfunction or permanent damage to the device.

Ratings	Symbol	Value	Unit
Electrical Ratings			
Supply voltage Steady-State Transient Conditions [(1)]	 $V_{CC(SUS)}$ $V_{CC(PK)}$	 36 50	 V
Supply Current Transient Conditions [(2)] Transient Negative Current (tT = 60ms) Transient Negative Current (tT = 1ms)	I_T	 1.0 -100 -1.3	 A mA A
Input Voltage [(3)] Ref/Dwell, Advance EST, Bypass	 V_{IN1} V_{IN2}	 -5.0 to 30 -5.0 to 24	 V
Ref/Dwell Input Current	I_{IN1}	-20	mA
Dwell ON Sink Current Output ON (Operating) Output ON (t = 10ms)	I_D	 0.3 0.8	 A
Dwell OFF Voltage [(4)]	$V_{D(OFF)}$	5.0	V
Thermal Ratings			
Storage Temperature	T_{STG}	-65 to 150	°C
Operating Ambient Temperature	T_A	-30 to 125	°C
Thermal Resistance			
Operating Junction Temperature	T_J	-30 to 150	°C
Thermal Resistance (Junction-to-Ambient) - SO8	$Ø_{J-A}$	80	°C/W
Peak Package Reflow Temperature During Reflow [(5),, (6),]	T_{PPRT}	Note 6	°C

Notes

1. Survivability of device with transient voltage applied to V_{CC} pin for a duration not to exceed 10ms.
2. Survivability of device with overvoltage applied to V_{CC} pin producing the current for a duration not to exceed 10ms.
3. Exceeding this voltage range on the function pin may cause permanent damage to the device.
4. A zener diode is incorporated across collector to emitter of the output NPN device to prevent voltage overdrive of the external Darlington switch transistor.
5. Pin soldering temperature limit is for 10 seconds maximum duration. Not designed for immersion soldering. Exceeding these limits may cause malfunction or permanent damage to the device.
6. Package Reflow capability meets Pb-free requirements for JEDEC standard J-STD-020C. For Peak Package Reflow Temperature and Moisture Sensitivity Levels (MSL),

Table 2. Static Electrical Characteristics

Characteristics noted under conditions 7.0 V≤V_{CC}≤18V， - 40°C≤T_A≤125°C, GND=0V unless otherwise noted. Typical values noted reflect the approximate parameter means at T_A=25°C under nominal conditions unless otherwise noted.

Characteristic	Symbol	Min	Typ	Max	Unit
Inputs					
Advance Input Resistance V_{CC} = 16 V, Ref/Dwell = 1.0 V, Advance = 1.0 mA, EST = Bypass = 0 V	$R_{(A)}$	15	18	25	kΩ
Advance Voltage [7] V_{CC} = 16 V, Ref/Dwell = 1.0 V, EST = Bypass = 0 V	$V_{TH(A)}$	-	0.05	0.1	V
Advance Threshold Voltage [7] V_{CC} = 16 V, Ref/Dwell = 1.0 V, EST = Bypass = 0 V Dwell = Reference = RPM Detect = open, Dwell Control = sinking 10 µA Increasing Decreasing Hysteresis	 $V_{TH+(A)}$ $V_{TH-(A)}$ $V_{HYS(A)}$	 V_B + 0.103 V_B + 0.045 0.018	 V_B + 0.114 V_B + 0.068 0.045	 V_B+0.130 - -	V
Bypass Input Resistance V_{CC} = 16 V, Ref/Dwell = Advance = 3.0 V, EST = Bypass = 0 V	$R_{(BP)}$	6.0	9.2	16	kΩ
Bypass Voltage V_{CC} = 16 V, Ref/Dwell = Advance = 1.0 V, EST = 0V	$V_{(BP)}$	-	0.065	0.1	V
Bypass Threshold Voltage [8] Ref/Dwell = Advance = 1.0 V, EST = 3.0 V Increasing Decreasing Hysteresis	 $V_{TH+(BP)}$ $V_{TH-(BP)}$ $V_{HYS(BP)}$	 V_B + 1.6 V_B + 0.9 0.65	 V_B + 0.188 V_B + 0.103 0.86	 V_B + 2.1 - -	V
Current Sense Threshold Voltage [9] V_{CC}= 16 V, Ref/Dwell = Advance = 1.0 V, EST = Bypass = 3.0 V	$V_{TH(CS)}$	90	105	121	mV
EST Input Resistance V_{CC} = 16 V, Ref/Dwell = Advance = 1.0 V, Bypass = 3.0 V	$R_{(EST)}$	7.0	10.3	18	kΩ
EST Input Voltage (EST Mode) V_{CC} = 16 V, Ref/Dwell = Advance = 1.0 V, Bypass = 3.0 V	$V_{(EST)}$	-	0.07	0.1	V

Notes

7. Advance Threshold Voltage is the positive (or negative) going voltage on Advance necessary cause the Dwell Control voltage to positive (or negative) going transition 2.0 V respectively. It is expressed as VTH±(A) = VB + VX where VB is the Bias Voltage and VX is the additional voltage necessary to attain the threshold.

8. Bypass Threshold Voltage is the positive (or negative) going voltage on Bypass necessary cause the Dwell voltage to positive (or negative) going transition 1.5 V respectively. It is expressed as VTH±(BP) = VB + VX where VB is the Bias Voltage and VX is the additional voltage necessary to attain the threshold.

9. Increasing voltage on Current Sense which when attained will cause Dwell to transition low to 1.5 V with a 10 mA load.

Table 2. Static Electrical Characteristics (continued)

Characteristics noted under conditions 7.0 V ≤ V_{CC} ≤ 18 V, - 40°C ≤ T_A ≤ 125°C, GND = 0 V unless otherwise noted. Typical values noted reflect the approximate parameter means at T_A = 25°C under nominal conditions unless otherwise noted.

Characteristic	Symbol	Min	Typ	Max	Unit
EST Threshold Voltage [10]					V
(Ref/Dwell = Advance = 1.0 V, Bypass = 3.0 V)					
Increasing	$V_{TH+(EST)}$	1.65	1.86	2.0	
Decreasing	$V_{TH-(EST)}$	0.8	0.89	-	
Hysteresis	$V_{HYS(EST)}$	0.79	0.97	-	
Ref/Dwell Current [11]	$I_{(R/D)}$				µA
(V_{CC} = 16 V, Advance = 1.0 V, EST = Bypass = 0 V)					
Ref/Dwell Voltage = 1.0 V		-12	-1.38	1.0	
Ref/Dwell Voltage = 20 V		-1.0	0.02	5.0	
Ref/Dwell Clamp Voltage	$V_{(R/D)CL}$				V
(V_{CC} = 16 V, Advance = 1.0 V, EST = Bypass = 0 V)					
$I_{R/D}$ = 100µA (Sourcing)		-0.01	-0.04	0.2	
$I_{R/D}$ = 1.0mA (Sourcing)		-0.62	-0.54	-	
Ref/Dwell Threshold (Bypass Mode) [12]					V
(Advance = 1.0 V, EST = Bypass = 0 V, Reference = sinking 10 µA)					
Increasing	$V_{TH+(R/D)BP}$	V_B+0.09	V_B+0.106	V_B+0.116	
Decreasing	$V_{TH-(R/D)BP}$	V_B+0.018	V_B+0.03	-	
Hysteresis	$V_{HYS(R/D)BP}$	0.055	0.076	-	
Ref/Dwell Threshold (EST Mode) [12]					V
(Advance = 1.0 V, EST = 0 V, Bypass = 3.0 V, Reference = sinking 10 µA)					
Increasing	$V_{TH+(R/D)EST}$	V_B+0.445	V_B+0.50	V_B+0.535	
Decreasing	$V_{TH-(R/D)EST}$	V_B+0.038	V_B+0.062	-	
Hysteresis	$V_{HYS(R/D)EST}$	0.395	0.436	-	
Ref/Dwell Threshold (No Pump) [13]					V
(Advance=1.0V, EST=Bypass=0V, Dwell =sinking 10 mA)					
Increasing	$V_{TH+(R/D)NP}$	V_B+0.003	V_B+0.118	V_B+0.128	
Decreasing	$V_{TH-(R/D)NP}$	V_B+0.021	V_B+0.047	-	
Hysteresis	$V_{HYS(R/D)NP}$	V_B+0.013	V_B+0.072	-	

Notes

10. EST Threshold Voltage is the positive (or negative) going voltage on EST necessary cause the Dwell voltage to positive (or negative) going transition 1.5 V respectively. It is expressed as $V_{TH\pm(EST)}$ and is in reference to ground.
11. Ref/Dwell can either source or sink current; A minus sign denotes the Ref/Dwell is sourcing current.
12. Ref/Dwell Threshold Voltage (Bypass Mode) is the positive (or negative) going voltage on Ref/Dwell necessary cause the Reference voltage to positive (or negative) going transition 1.5 V respectively. It is expressed as $V_{TH\pm(RD)} = V_B + V_X$ where V_B is the Bias Voltage and V_X is the additional voltage necessary to attain the threshold.
13. Ref/Dwell Threshold Voltage (No Pump) is the positive (or negative) going voltage on Ref/Dwell necessary cause the Dwell voltage to positive (or negative) going transition 1.5 V respectively. It is expressed as $V_{TH\pm(RD)} = V_B + V_X$ where V_B is the Bias Voltage and V_X is the additional voltage necessary to attain the threshold. Advance = 1.0 V providing no input assist or "No Pump" influence of Dwell signal; Reference open.

Table 2. Static Electrical Characteristics (continued)

Characteristics noted under conditions 7.0 V ≤ V_{CC} ≤ 18 V, - 40°C ≤ T_A ≤ 125°C, GND = 0 V unless otherwise noted. Typical values noted reflect the approximate parameter means at T_A = 25°C under nominal conditions unless otherwise noted.

Characteristic	Symbol	Min	Typ	Max	Unit
Ref/Dwell Threshold (Max Pump) (14) (V_{CC} = 16 V, Advance = 3.0 V, EST = Bypass = 0 V, Dwell sinking 10 mA, Dwell Control = open) Increasing Decreasing Hysteresis	$V_{TH+(R/D)MP}$ $V_{TH-(R/D)MP}$ $V_{HYS(R/D)M}$P	V_B+0.175 V_B+0.115 V_B+0.025	V_B+0.474 V_B+0.425 V_B+0.048	V_B+0.80 V_B+0.73 5 -	V
Outputs					
Bias Resistance to Ground Dwell =V_{CC}=Ref/Dwell=Reference= Dwell Control = open, Advance = 1.0 V, EST = Bypass = 0 V	$R_{(B)}$	0.55	0.68	0.9	kΩ
Bias Voltage (Bypass Mode) Ref/Dwell = Advance = 1.0 V, EST = Bypass = 0 V	$V_{(B)BP}$	2.25	2.43	2.6	V
Bias Voltage Regulation (Bypass Mode) Ref/Dwell = Advance = 1.0 V, EST = Bypass = 0 V	$V_{(B)BP}$	-	30	40	mV
Bias Voltage (EST Mode) V_{CC} = 16 V, Ref/Dwell = Advance = 1.0 V, EST = 0 V, Bypass =3.0 V	$V_{(B)EST}$	1.9	2.04	2.2	V
Dwell Saturation Voltage V_{CC} = 4.0 V, I_D = 40mA, Ref/Dwell = Advance =3.0 V, EST = Bypass = 0 V V_{CC} = 16 V, I_D = 160mA, Ref/Dwell = Advance =3.0 V, EST = Bypass = 0 V V_{CC} = 24 V, I_D = 240mA, Ref/Dwell = Advance =1.0 V, EST = Bypass = 3.0 V V_{CC} = 36 V, I_D = 360mA, Ref/Dwell = Advance =1.0 V, EST = Bypass = 3.0 V	$V_{(D)SAT}$	- - - -	0.05 0.14 0.20 0.29	0.1 0.24 0.35 0.5	V
Dwell Reverse Clamp Voltage (15)	$V_{(D)REV}$	-0.9	-0.98	-1.2	V
Dwell Leakage Current (16) V_{CC} = 16 V, Dwell = 5.0 V, Ref/Dwell = Advance = 3.0 V, EST =Bypass = 0, Bias Voltage = Reference = open	$I_{(D)KG}$	-	0.044	50	μA
Reference Low (17) I_R = sinking 0.3 mA, Ref/Dwell = Advance = 1.0 V, EST = Bypass =0 V	$V_{(R)LOW}$	-	0.13	0.22	V

Notes

14. Ref/Dwell Threshold Voltage (Max Pump) is the positive (or negative) going voltage on Ref/Dwell necessary cause the Dwell voltage to positive (or negative) going transition 1.5 V respectively. It is expressed as $V_{TH\pm(RD)} = V_B + V_X$ where V_B is the Bias Voltage and V_X is the additional voltage necessary to attain the threshold. Advance = 3.0V providing maximum input assist or Max Pump" influence of Dwell signal; Reference = Dwell Control = open.

15. All pins open except Pwr Gnd with Dwell sinking 200 mA.

16. Limit conditions with Dwell output NPN in the OFF condition.

17. Reference saturation voltage to ground with 0.3mA of current going into the Reference.

Table 2. Static Electrical Characteristics (continued)

Characteristics noted under conditions 7.0 V ≤ V_{CC} ≤ 18 V, - 40°C ≤ T_A ≤ 125°C, GND = 0 V unless otherwise noted. Typical values noted reflect the approximate parameter means at T_A = 25°C under nominal conditions unless otherwise noted.

Characteristic	Symbol	Min	Typ	Max	Unit
Reference High/Un-Clamped (27) V_{CC} = 4.0 V, I_R = sourcing 100 mA, Ref/Dwell = 3.0 V, Advance =1.0 V, EST = Bypass = 0 V	$V_{(R)HI/UNCL}$	3.2	3.36	-	V
Reference High/Clamped (27) V_{CC} = 16 V, Ref/Dwell = 3.0 V, Advance = 1.0 V, EST = Bypass = 0 V I_R = sourcing 10 µA I_R = sourcing 1.0 mA	$V_{(R)HI/CL}$	- 12	5.41 15.3	6.0 -	V
Controls					
Dwell Control Negative Clamp Voltage (27) V_{CC} = 16 V, I_{DC} = sourcing 100 µA, Ref/Dwell = Advance = 1.0 V, EST= Bypass = 0 V	$V_{(DC)-CL}$	0.5	0.7	0.8	V
Dwell Control Positive Clamp Voltage (27) V_{CC} = 16 V, I_{DC} = sinking 100 µA, Ref/Dwell = 1.0 V, Advance = Open,EST = Bypass = 0 V	$V_{(DC)+CL}$	8.0	8.2	8.4	V
Dwell Control Charge Current (27) V_{CC} = 16 V, Ref/Dwell = 1.0 V, Advance = Dwell Control = 3.0 V, EST= Bypass = 0 V	$I_{(DC)CHG}$	30	47	58	µA
Dwell Control Discharge Current (27) V_{CC} = 16 V, Current Sense = 0.5 V, Ref/Dwell = Advance = 1.0 V, EST= Bypass = 0 V	$I_{(DC)DISCHG}$	18	33	48	µA
Dwell Control Input Current (27) V_{CC} = 16 V, Ref/Dwell = Advance = 1.0 V, EST = Bypass = 0 V, Dwell Control = 7.0 V	$I_{(DC)SINK}$	-	1.1	2.5	µA
RPM Detect Charge Current ON (27) V_{CC} = 16 V, Ref/Dwell = 3.0 V, Advance = 1.0 V, EST = Bypass = 0 V	$I_{(RPM)CHG}$	-4.0	0.54	1.0	mA
RPM Detect Current (27) V_{CC} = 16 V, 1.0 V = Ref/Dwell = Advance = 3.0 V, EST = Bypass = 0 V RPM Detect = 0.5 V RPM Detect = 1.5 V	$I_{(RPM)LKG}$	04.0 -0.1	0.55 0.01	1.0 0.1	µA
RPM Detect Clamp Voltage (27) V_{CC} = 16 V, Ref/Dwell = 3.0 V, Advance = 1.0 V, EST = Bypass =0 V, RPM Detect = sourcing 16 µA	$V_{(RPM)CL}$	2.4	2.5	2.7	V

Notes

18. Dwell Control adjusts the reference voltage of Dwell Comparator
19. Dwell Control. sourcing 100 µA.
20. Dwell Control sinking 100 µA.
21. Dwell Control at 3.0 V; Internal Dwell Control transistor OFF
22. Dwell Control at 3.0 V; Internal Dwell Control transistor ON.
23. Dwell Control at 7.0 V; Internal Dwell Control transistor OFF.
24. Q53 and Q54 both ON; Measured with RPM Detect voltage at 0.5 V to reflect maximum source current capability. See Typical Applications on page 9
25. Q53 and Q54 both OFF; Measured with RPM Detect voltage at 0.5 V and 1.5 V to reflect maximum leakage current. See Typical Applications on page 9
26. Q53 and Q54 both ON; RPM Detect sinking 16 µA. See Typical Applications on page 9

Table 2. Static Electrical Characteristics (continued)

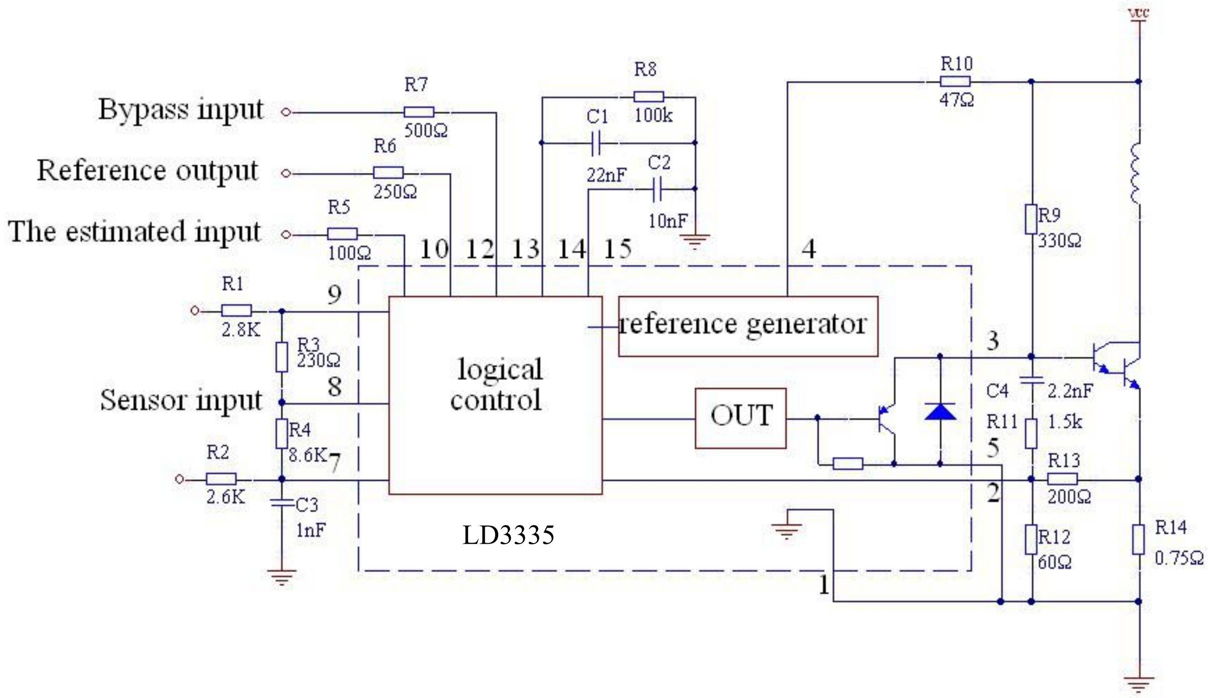
Characteristics noted under conditions 7.0 V ≤ V_{CC} ≤ 18 V, - 40°C ≤ T_A ≤ 125°C, GND = 0 V unless otherwise noted. Typical values noted reflect the approximate parameter means at T_A = 25°C under nominal conditions unless otherwise noted.

Characteristic	Symbol	Min	Typ	Max	Unit
RPM Detect Threshold [27]	$V_{TH-(RPM)}$				V
V_{CC} = 16 V, Ref/Dwell = Advance = 3.0 V, EST = Bypass = 0 V		0.8	0.92	1.0	
RPM Detect Charge Current	$I_{(RPM)CHG}$				mA
V_{CC} = 16 V, Ref/Dwell = 3.0 V, Advance = 1.0 V, EST = Bypass = 0 V		-	-2.0	-	

Notes

27. Decreasing Threshold; RPM Detect voltage decreased from 0.6 V until Dwell voltage transitions low to 1.5 V with 10 mA load.

Typical Applications



Package Information

SOP16L(W)

Dimensions in mm