CS2516

Pulse-Load Battery Monitor

Description

The CS2516 is designed for use in battery powered medical, security, or environmental systems where prior notification of impending power source failure is a requirement. The IC effectively provides continuous monitoring of battery condition by pulse-sampling the system voltage at predetermined intervals. Low standby current permits unswitched connection to the battery with minimal impact on operating life. The ability to load the battery during the test pulse provides assurance that sufficient reserve capacity exists to operate critical system components.

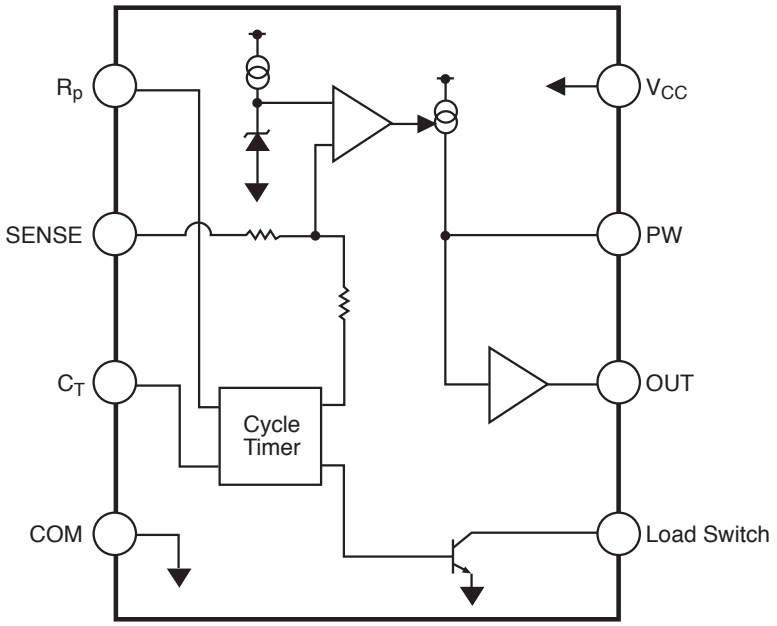
The CS2516 contains an internal timer that generates a 1.0 millisecond test pulse once each 33 seconds (both times are typical). The load switch transistor conducts only during the test pulse, and can sink up to 50mA directly. An external transistor can be added to increase the load current capability.

Should, during the test pulse, the sense terminal voltage fall below the threshold level determined by the internal (synthesized) temperature compensated zener diode, the comparator will permit a charging current to flow out of PW. This pin is also the input of a Schmitt trigger that in turn drives the output transistor. Collectively, the charge current and trigger, in conjunction with an external RC network, operate as a "pulse-stretcher" to provide output "ON" times that are a multiple of the sampling time. This feature permits low battery alarm devices or visible annunciators to be driven directly by the IC. The maximum permissible output current is 30mA.

Features

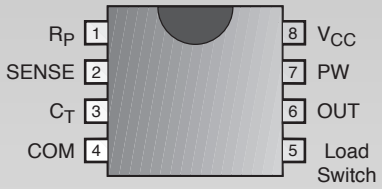
- **Adjustable Battery Sense from 7 to 12 Volts**
- **Pulse Loads Battery at up to 50mA**
- **Standby Current Under 10μA**
- **Test Period, Rate and Load Adjustable**
- **On Chip 15mA Output Driver**

Block Diagram



Package Options

8L PDIP and 8L SO



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Absolute Maximum Ratings

Supply Voltage (V_{CC}) ..... 0 to 14V
R_p Input Voltage ..... -0.5 to V_{CC}
SENSE, C_T, PW, Output and Load Switch ..... -0.5 to 8V
Load Current 50mA
Output Current 30mA
Storage Temperature ..... -40 to +150˚C
Lead Temperature Soldering: Wave Solder (through hole styles only) ..... 10 sec. max, 260°C peak
Reflow (SMD styles only) ..... 60 sec. max above 183°C, 230°C peak

Electrical Characteristics: V_{CC} = 9V, R_p = 9.1 MΩ, C_T = 4.7μF, Cpw = 0.1μF, Rpw = 10MΩ, 0° ≤ T_A ≤ 85° unless otherwise specified.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
■ V_{CC}					
Operating Voltage			9	12	V
Standby Current			4	10	μA
■ Cycle Timer					
Charge Current	V_{C_T}=0V, 6V≤V_{CC}≤12V	-1.70	-1.20	-0.48	μA
	2V ≤ V_{C_T} < 7.5V	-0.77	-0.74	-0.71	μA
Discharge Current	V_{C_T}= 8.8V	8.0	20.0	25.0	mA
	V_{C_T}= 2.0V	1.1	3.0	3.6	mA
Discharge Impedance	4.6V < V_{C_T}< 8.0V		440		Ω
Upper Charge Threshold	-0.48μA < I_{C_T} < -1.70μA	7.0	8.0	9.0	V
Lower Charge Threshold	-0.48μA < I_C < -1.70μA	0.5	1.0	3.0	V
Lower Discharge Threshold	1.1mA < I_C< 25mA	2.0	4.6	6.0	V
■ Load Switch					
"ON" Voltage	$I_{Load\ Switch}$ = 50mA		0.3	0.5	V
"OFF" Current	$V_{Load\ Switch}$ = 12V			1.0	μA
■ Sense Input					
Threshold Voltage		6.3	6.7	7.1	V
Threshold Temp Coefficient	0°C < T_A < 85°C		150		ppm/°C
Active Impedance		5.0	8.5	12.0	kΩ
■ Pulse Stretcher					
Source Current	V_{SENSE} = 6.3V, V_{PW} = 0V	-950	-550	-250	μA
	V_{CC}=V_{SENSE}=6.3V, V_{PW} = 0V	-300	-250	-200	μA
Schmitt Upper Threshold		2.25	2.50	2.75	V
Hysteresis		0.60	1.00	1.40	V
Input Bias Current	V_{SENSE}=7.1V, V_{PW}=1.2V			1.00	μA
■ Output Switch					
"ON" Voltage	V_{PW} = 3V; I_{OUT} = 15mA		0.1	0.5	V
"OFF" Current	V_{PW} = 0V; V_{OUT} = 12V			1.0	μA

Electrical Characteristics: V_{CC} = 9V, R_P = 9.1 MΩ, C_T = 4.7μF, Cpw = 0.1μF, Rpw = 10MΩ, 0° ≤ T_A ≤ 85° unless otherwise specified

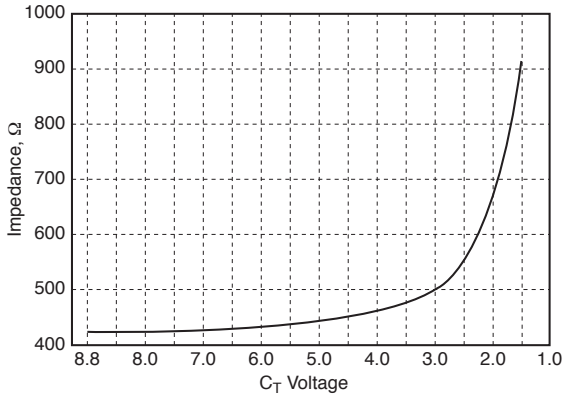
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
■ **Recommended Component Values**					
Rp Program Resistor		1.0		9.1	MΩ
C_T Cycle Timer Capacitor		4.7		22.0	μF
C_{PW} Pulse Stretcher Capacitor		0.01		0.10	μF
R_{PW} Pulse Stretcher Resistor		1		10	MΩ

Package Pin Description

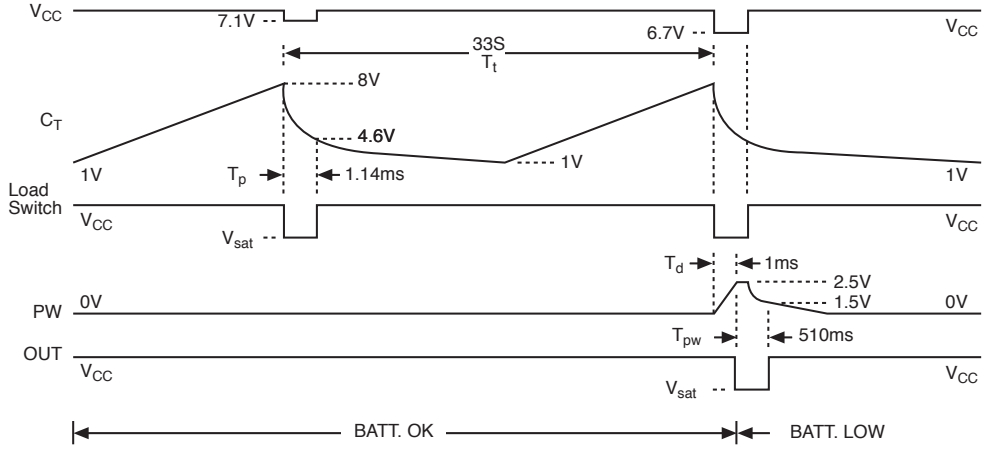
PACKAGE PIN #	PIN SYMBOL	FUNCTION
8L PDIP & SO Narrow		
1	R_P	Test period programming resistor.
2	SENSE	Voltage sense comparator input.
3	C_T	Test period, duration programming capacitor.
4	COM	Common negative
5	Load Switch	Collector of pulse loading NPN transistor.
6	OUT	Alarm Pulse width-stretcher output
7	PW	Output pulse-width programming RC.
8	V_{CC}	Power source.

Typical Performance Characteristics

C_T Discharge Impedance vs C_T Voltage (Typ +25°C)



Timing Diagram



Applications Formulae and Typical Values

Program and Standby Currents: $I_P = \frac{V_{CC}}{R_P} = \frac{9V}{9.1m\Omega} \approx 1\mu A$ Standby Current = $4I_P = 4\mu A$ (typ.)

Cycle Timer Period: $T_t = \frac{V_T C_T}{I_P} = \frac{7C_T}{1\mu A} = \frac{7 \times 4.7\mu F}{1\mu A} \approx 33sec.$,

where V_t = Upper Charge Threshold - Lower Charge Threshold (7V typ.)

Test Pulse Width: $T_p = R_d C_T \times \ln(V_P) \approx 242C_T \approx 242 \times 4.7\mu F \approx 1.14ms$

where R_d is the dynamic cycle timer discharge impedance (440Ω typ.)

$$\text{and } V_P = \frac{\text{Upper Charge Threshold}}{\text{Lower Discharge Threshold}} \quad [1n(V_P) = 0.55 \text{ typ.}]$$

Pulse Stretcher: Delay Time: $T_D = \frac{V_d C_{PW}}{I_{src}} = \frac{2.5C_{PW}}{250\mu A} = \frac{2.5 \times 0.1\mu F}{250\mu A} \approx 1ms$

where V_d = Schmitt Trigger Upper Threshold (2.5V typ.)

and I_{src} = Typical source current at the PW pin at the nominal low battery sense threshold of 6.7V.

Pulse Width: $T_p = C_{PW} R_{PW} \ln(V_S) \approx 0.51 \times 0.1\mu F \times 10m\Omega \approx 510ms$.

$$\text{and } V_S = \frac{\text{Schmitt Trigger Upper Threshold}}{\text{Schmitt Trigger Hysteresis}} \quad [\ln(V_S) = 0.51 \text{ typ.}]$$

Applications Information

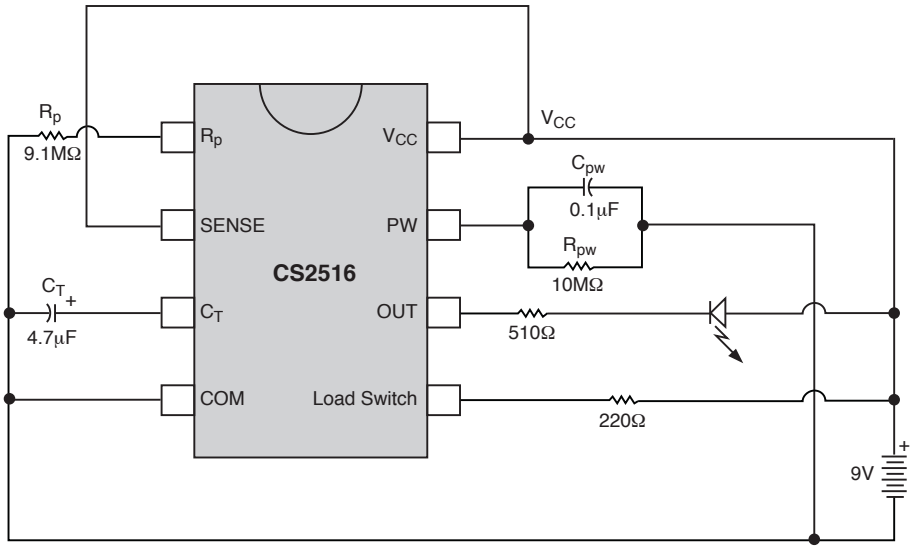
The value of R_p affects standby current, operating current, and the test cycle period. The recommended value is (V+/1μA) where V+ is the fresh battery voltage. Higher values of R_p are not recommended. Minimum recommended value is (V+/10μA) which will increase both the standby and operating currents by 10X and reduce the test cycle period by the same factor; the test pulse width will be unaffected.

The value of C_t affects both the test cycle period and the test pulse width. Of critical importance is the selection of a low leakage type capacitor; if leakage current exceeds the cycle timer charge current, the timer will not operate.

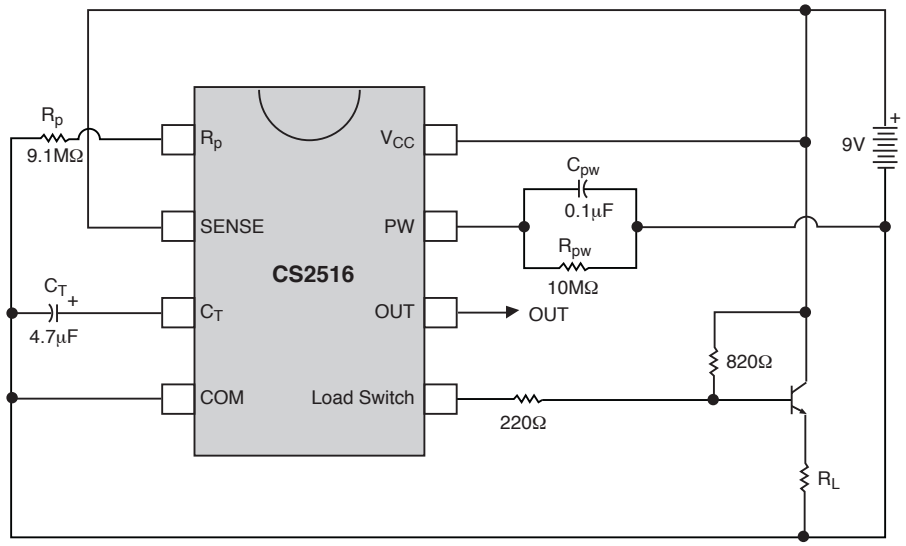
The pulse stretcher components R_{PW} and C_{PW} should be selected such that the delay timer to charge C_{PW} is shorter than the test pulse width programmed by C_t to guarantee operation of the Output. The output is an open-collector transistor which may be used to drive an indicator device directly or to interface to logic family devices.

The SENSE input typical 8.5kΩ input impedance appears only during the test pulse; otherwise the SENSE input is in a high impedance state. The effective low battery threshold voltage can be modified (increased only) by means of a voltage divider placed across the load resistor. This technique can also be used to effectively reduce the threshold tolerance band.

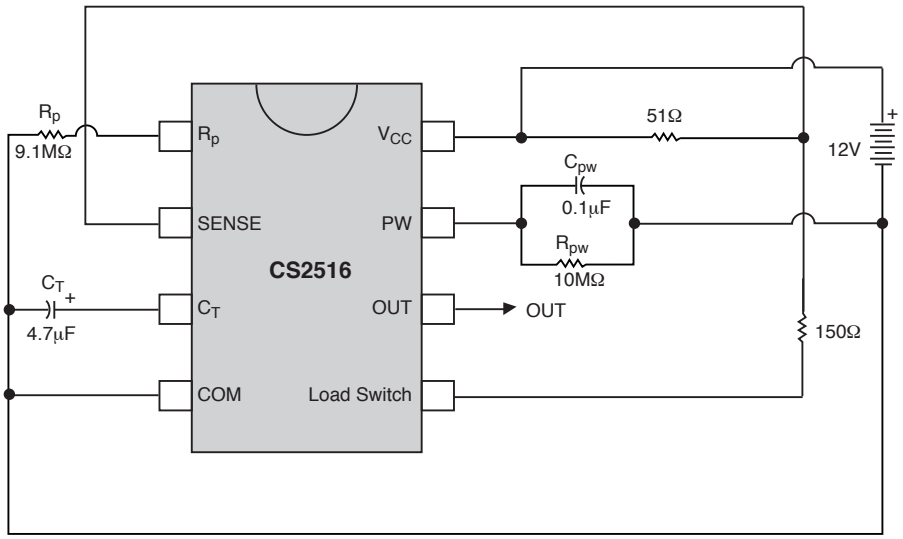
Typical Application Circuit



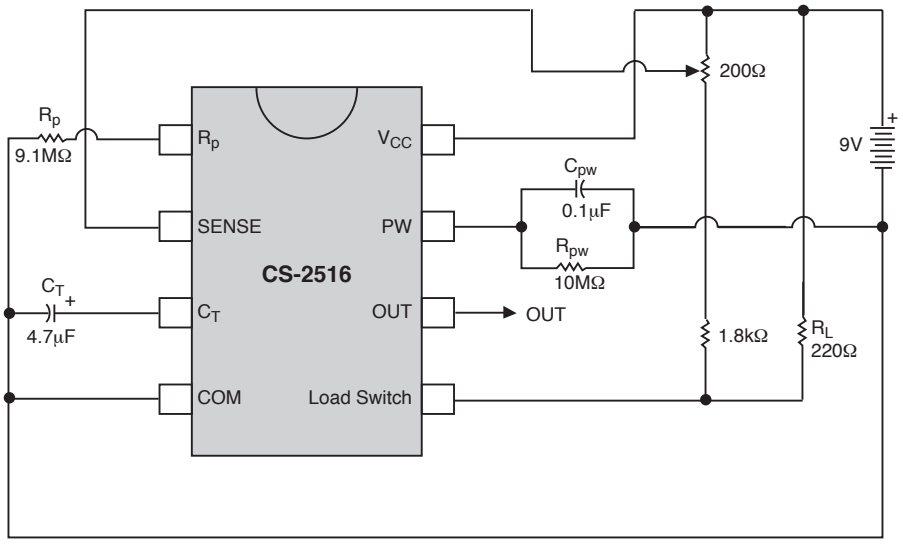
Increased Pulse-Load Current Capability



12V Battery Application with 9V Threshold



Adjustable Sense Threshold



Package Specification

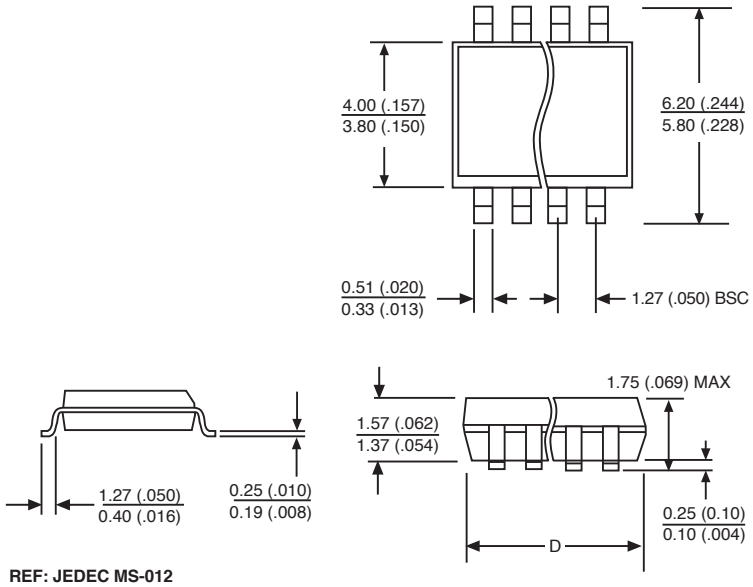
PACKAGE DIMENSIONS IN mm (INCHES)

Lead Count	D			
	Metric		English	
	Max	Min	Max	Min
8L PDIP	10.16	9.02	.400	.355
8L SOIC	5.00	4.80	.197	.189

PACKAGE THERMAL DATA

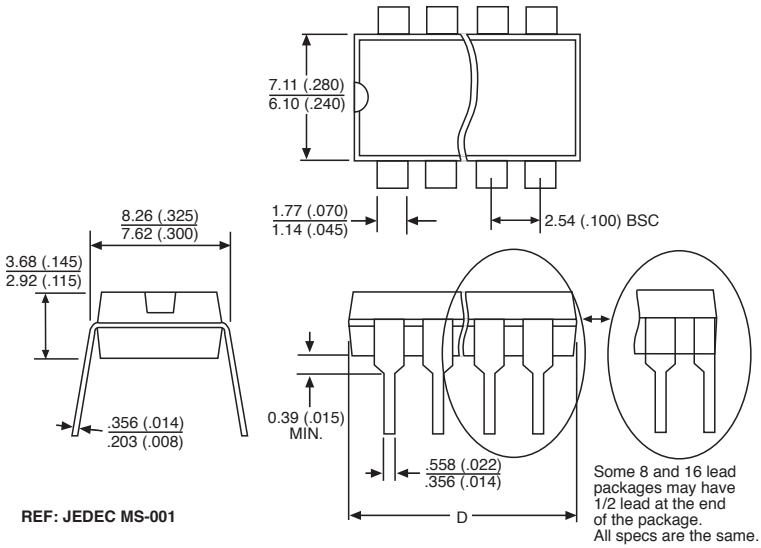
Thermal Data		8L PDIP	8L SO	
$R\Theta_{JC}$	typ	52	45	°C/W
$R\Theta_{JA}$	typ	100	165	°C/W

Surface Mount Narrow Body (D); 150 mil wide



REF: JEDEC MS-012

Plastic DIP (N); 300 mil wide



REF: JEDEC MS-001

Ordering Information

Part Number	Description
CS2516KN8	8 Lead PDIP
CS2516KD8	8 Lead SOIC
CS2516KDR8	8 Lead SOIC *(tape & reel)*

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