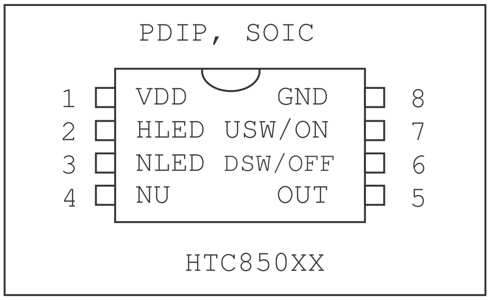
PWM for DC Power Controller

1.0 General description.

This circuit is designed to work as power controller using **P**ulse **W**idth **M**odulation (**PWM)** technique. Operational PWM frequency is 15625Hz. Two outputs are provided for controlling power output indicator LEDs. Those two LEDs are used to show output Duty cycle.
This controller can be used for DC control applications such as:

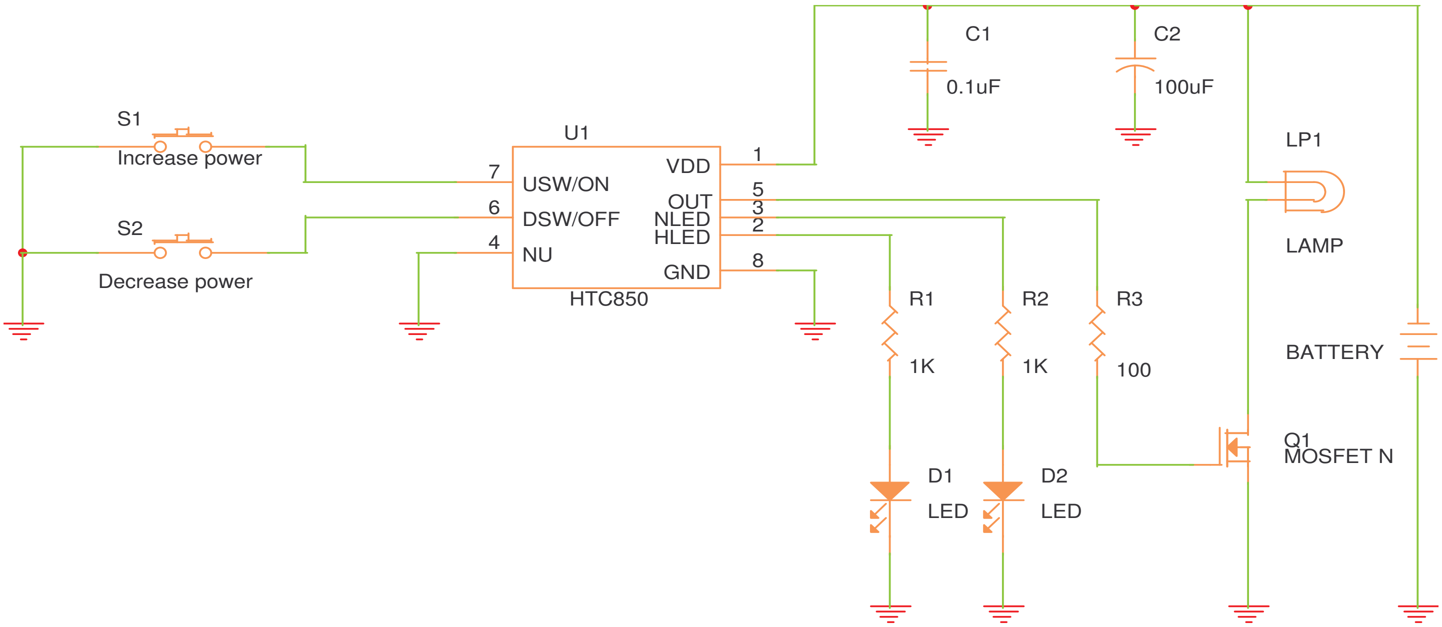
- Flash light controller.
- DC motor speed controller.
- Analog output generation using external filter.
- Back light brightness controller.
- Instrumental panel illumination controller.



Features:

- Single chip solution
- Minimum external components
- Six control bits or sixty - four power control levels
- Output pulse duration control with granularity of 1uS (1 - 63uS)
- Low power consumption
- High PWM frequency 15625Hz.
- Up to 95% efficient power control designs are possible using this IC
- Eliminates need for ON/OFF switch due to entering into sleep state with minimal power consumption
- Internally de-bounced switch inputs

Flashlight Controller using HTC850



2.0 Functional Description.

We will use the schematics above to describe HTC850 operation. At power up HTC850 goes thru internal reset, which lasts about 18mS. During this time all outputs are tri-stated. After internal reset HTC850 drives all outputs to GND and enters SLEEP State. In this state HTC850 consumes minimum power and eliminates need for ON/OFF switch.

As soon as USW/ON input detects key activity output starts generating PWM signal with minimum duty cycle (1uS). S1 and S2 are used to adjust output power (PWM duty cycle). S1 increases and S2 decreases output power (PWM duty cycle). If PWM duty cycle is decreased to 0 then HTC850 enters SLEEP state.

D2 and D1 are used for output duty cycle indicators. D2 turns on when output power is set to be less then or equal 50% (50% PWM duty cycle). D1 turns on when output power is set to be more then 50% (50% PWM duty cycle). R1 and R2 are used as current limiting resistors for diodes. Q1 is used as output driver.

Following parameters are important for Q1 selection:

1. RDS_{on} - on state resistance specified at 3V GS (Gate Source) or less. Smaller resistance results in better efficiency. It is easy to find MOSFETS with RDS_{on} specified at less then 0.01 ohms.
2. Maximum power dissipation should be more then $P_{max} = (I_{LP1})^2 * RDS_{on.}$ I_{LP1} stand for LP1 Lamp rated current.
3. I_{DS} max (maximum current allowed through Drain Source) should be more then I_{LP1}.

This design can work with 3V to 4.5V total battery voltage (two to three 1.5V batteries). Same circuit, with slight modifications, can work from higher voltage batteries. Please see application notes on using HTC850.

Please note that R1, R2, D1 and D2 are not essential for HTC850 operation. They are optional and could be used for initial design. In the sleep state of HTC850 those LEDs are not powered.

C1 and C2 selection should be done to make sure that they have leakage current in uA range. It is important to guarantee long battery life. When HTC850 is in sleep state it consumes very little energy and battery discharge occurs mainly thru C1 and C2 leakage. To insure long shelf life of this flashlight design one has to make sure that the total discharge current from this circuit is less then internal leakage current of the battery during sleep (off) state.

If we use Super Bright LED as light source, instead of LP1, then Q1 and LP1 can be omitted assuming that we use less then 25ma to drive the LED. Connect Super Bright LED to output similarly to D1 (D2) connection using R3 resistor. R3 resistor value should be calculated per LED used and should insure that output current does not exceed maximum allowed range for HTC850.

Pin out description.

Abbreviations used: O - output, I - input, P - power.

Pin	Name	I / O	Description	Notes
1	VDD	P	Power	+2.5V to +5.5V
2	HLED	O	High output power indicator	Turns on when duty cycle is grater then 50%.
3	NLED	O	Normal output power indicator	Turns on when duty cycle is less then 50%.
4	NU	I	Not Used	Tie it to GND or VDD.
5	OUT	O	PWM signal output	Use driver if more then 25mA source needed.
6	DSW/OFF	I	Down Switch input for PWM	When activated decreases PWM duty cycle. This input is Internally de-bounced for error free operation.
7	USW/ON	I	Up Switch input for PWM	When activated decreases PWM duty cycle. This input is Internally de-bounced for error free operation.
8	GND	P	Ground	Connect to ground.

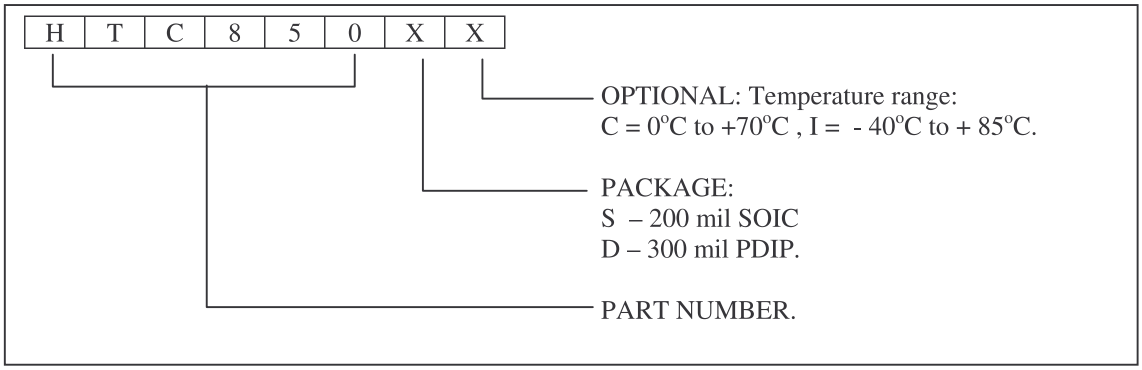
3.0 Electrical characteristics.

Voltage on VDD pin in respect to GND	+2.5 to +5.5V
Operational current with no external load	3 mA[1]
Current used in SLEEP state	4uA[1]
$\text{OUTX}_{\text{output low voltage max (5mA load)}}$	0.4V[1]
$\text{OUTX}_{\text{output high voltage min (5mA source)}}$	VDD-0.7V[1]
$\text{OUTX}_{\text{maximum sink current}}$	25mA[1]
$\text{OUTX}_{\text{maximum source current}}$	25mA[1]
$\text{PWM}_{\text{Frequency over temperature an voltage range}}$	15625Hz ± 10%
$\text{PWM}_{\text{number of steps}}$	64
PWM_{step}	1uS ± 10%

NOTES:

1. Those values are characterized but not tested.

4.0 Ordering information.



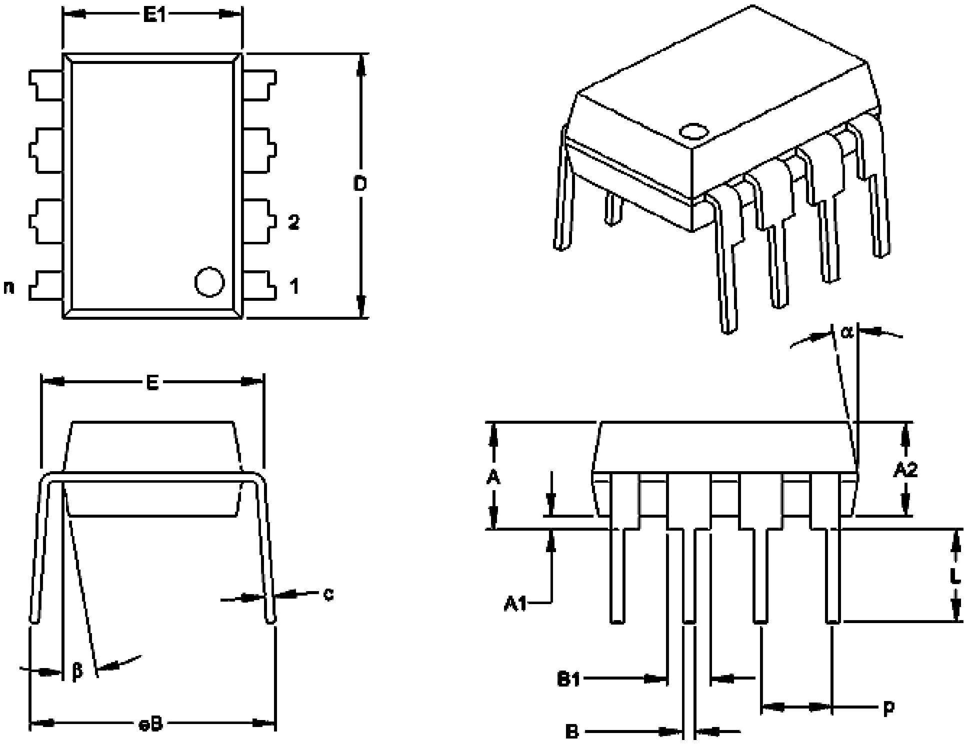
OPTIONAL: Temperature range:
C = 0°C to +70°C , I = - 40°C to + 85°C.

PACKAGE:
S – 200 mil SOIC
D – 300 mil PDIP.

PART NUMBER.

5.0 Mechanical Information

8-Lead Plastic Dual In-line (P) – 300 mil (PDIP)



Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	p		.100			2.54	
Top to Seating Plane	A	.140	.155	.170	3.56	3.94	4.32
Molded Package Thickness	A2	.115	.130	.145	2.92	3.30	3.68
Base to Seating Plane	A1	.015			0.38		
Shoulder to Shoulder Width	E	.300	.313	.325	7.62	7.94	8.26
Molded Package Width	E1	.240	.250	.260	6.10	6.35	6.60
Overall Length	D	.360	.373	.385	9.14	9.46	9.78
Tip to Seating Plane	L	.125	.130	.135	3.18	3.30	3.43
Lead Thickness	c	.008	.012	.015	0.20	0.29	0.38
Upper Lead Width	B1	.045	.058	.070	1.14	1.46	1.78
Lower Lead Width	B	.014	.018	.022	0.36	0.46	0.56
Overall Row Spacing	eB	.310	.370	.430	7.87	9.40	10.92
Mold Draft Angle Top	α	5	10	15	5	10	15
Mold Draft Angle Bottom	β	5	10	15	5	10	15

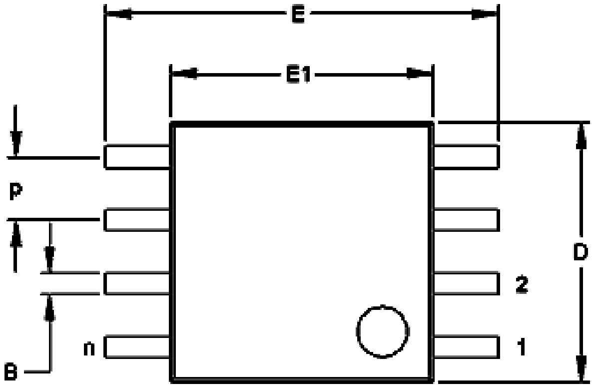
*Controlling Parameter

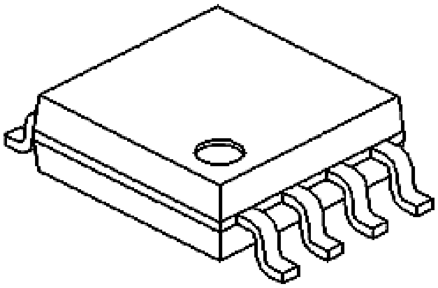
Notes:

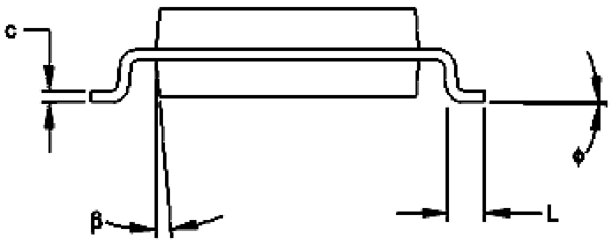
Dimensions D and E1 do not include mold flash protrusions. Mold flash or protrusions shell not exceed .010" (0.254mm)per side.

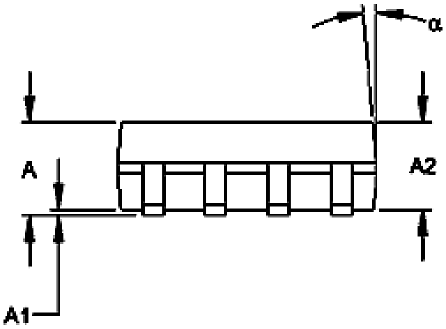
JEDEC Equivalent:MS-001

8-Lead Plastic Small Outline (SM) – Medium, 208 mil (SOIC)









Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	P		.050			1.27	
Overall Height	A	.070	.075	.080	1.78	1.97	2.03
Molded Package Thickness	A2	.069	.074	.078	1.75	1.88	1.98
Standoff	A1	.002	.005	.010	0.05	0.13	0.25
Overall Width	E	.300	.313	.325	7.62	7.95	8.26
Molded Package Width	E1	.201	.208	.212	5.11	5.28	5.38
Overall Length	D	.202	.205	.210	5.13	5.21	5.33
Foot Length	L	.020	.025	.030	0.51	0.64	0.76
Foot Angle	φ	0	4	8	0	4	8
Lead Thickness	c	.008	.009	.010	0.20	0.23	0.25
Lead Width	B	.014	.017	.020	0.36	0.43	0.51
Mold Draft Angle Top	α	0	12	15	0	12	15
Mold Draft Angle Bottom	β	0	12	15	0	12	15

*Controlling Parameter

Notes:

Dimensions D and E1 do not include mold flash protrusions. Mold flash or protrusions shell should not exceed .010” (0.254mm)per side.

High Tech Chips, Inc.
www.hightechips.com
info@hightechips.com