HV823

High-Voltage EL Lamp Driver IC

Features

- 2V to 9.5V Operating Supply Voltage
- DC-to-AC Conversion
- 180V Peak-to-Peak Typical Output Voltage
- Large Output Load Capability Typically 50 nF
- Permits the use of High-resistance Elastomeric Lamp Components
- Adjustable Output Lamp Frequency to Control Lamp Color, Lamp Life and Power Consumption
- Adjustable Converter Frequency to Eliminate Harmonics and Optimize Power Consumption
- Enable/Disable Function
- Low Current Draw under No-load Condition

Applications

- Handheld Personal Computers
- Electronic Personal Organizers
- GPS Units
- Pagers
- Cellular Phones
- Portable Instrumentation

General Description

The HV823 is a high-voltage driver designed for driving Electroluminescent (EL) lamps of up to 50 nF. EL lamps greater than 50 nF can be driven for applications not requiring high brightness. The input supply voltage range is from 2V to 9.5V. The device uses a single inductor and a minimum number of passive components. The nominal regulated output voltage that is applied to the EL lamp is ±90V. The chip can be enabled by connecting the resistors on the RSW-Osc pin and the REL-Osc pin to the VDD pin, and disabled when connected to GND.

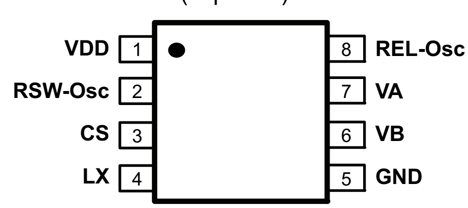
The HV823 has two internal oscillators, a switching MOSFET, and a high-voltage EL lamp driver. The frequency of the switching converter MOSFET is set by an external resistor connected between the RSW-Osc pin and the V_{DD} supply pin. The EL lamp driver frequency is set by an external resistor connected between the REL-Osc pin and the V_{DD} pin. An external inductor is connected between the LX pin and the V_{DD} pin. A 0.01 µF to 0.1 µF capacitor is connected between the C_S pin and the GND. The EL lamp is connected between the VA and VB pins.

The switching MOSFET charges the external inductor and discharges it into the C_S capacitor. The voltage at C_S will start to increase. Once the voltage at C_S reaches a nominal value of 90V, the switching MOSFET is turned OFF to conserve power. The output pins V_A and V_B are configured as an H-bridge and are switched in opposite states to achieve 180V peak-to-peak across the EL lamp.

For additional information, see application note *ANH34*.

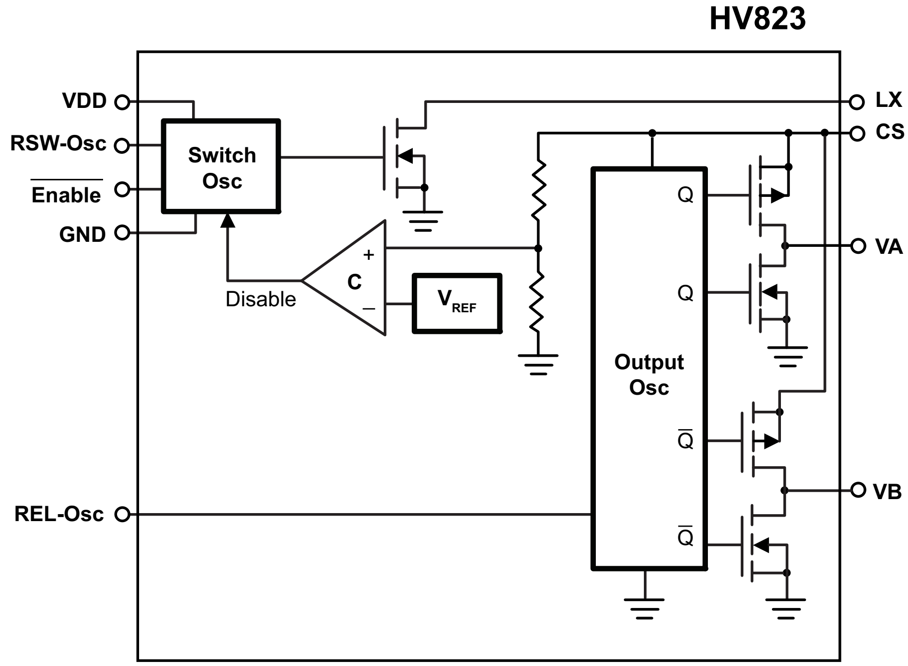
Package Type

8-lead SOIC
(Top view)



See Table 2-1 for pin information.

Functional Block Diagram



Note: $\overline{\text{Enable}}$ is available in die form only.

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings (†)

Supply Voltage, V_{DD} .... –0.5V to 10V
Output Voltage, V_{CS} .... –0.5V to 120V
Operating Temperature Range, T_A .... –25°C to +85°C
Storage Temperature Range, T_S .... –65°C to +150°C
Power Dissipation:
8-lead SOIC .... 400 mW

† **Notice:** Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Supply Voltage	V_{DD}	2	—	9.5	V	
Operating Temperature	T_A	–25	—	+85	°C	

DC ELECTRICAL CHARACTERISTICS

Electrical Specifications: V_{IN} = 3V, R_{SW} = 750 KΩ, R_{EL} = 2 MΩ, T_A = 25°C unless otherwise specified.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
On Resistance of Switching Transistor	$R_{DS(ON)}$	—	2	6	Ω	I = 100 mA
Output Voltage V_{CS} Regulation	V_{CS}	80	90	100	V	V_{IN} = 2V to 9.5V
Output Peak-to-Peak Voltage	$V_A–V_B$	160	180	200	V	V_{IN} = 2V to 9.5V
Quiescent V_{DD} Supply Current, Disabled	I_{DDQ}	—	30	100	nA	R_{SW-OSC} = Low
V_{DD} Supply Current	I_{DD}	—	150	200	µA	V_{IN} = 3V (See **Section 3.1 "Test Circuit VIN = 3V"**.)
		—	—	300	µA	V_{IN} = 5V (See **Section 3.2 "Typical 5V Application"**.)
		—	—	500	µA	V_{IN} = 9V (See **Section 3.3 "Typical 9V Application"**.)
Input Current Including Inductor Current	I_{IN}	—	25	33	mA	V_{IN} = 3V (See **Section 3.1 "Test Circuit VIN = 3V"**.)
Output Voltage on V_{CS}	V_{CS}	60	70	85	V	V_{IN} = 3V (See **Section 3.1 "Test Circuit VIN = 3V"**.)
$V_A–V_B$ Output Drive Frequency	f_{EL}	330	380	450	Hz	V_{IN} = 3V (See **Section 3.1 "Test Circuit VIN = 3V"**.)
Inductor Switching Frequency	f_{SW}	50	60	70	KHz	V_{IN} = 3V (See **Section 3.1 "Test Circuit VIN = 3V"**.)
Switching Transistor Duty Cycle	D	—	88	—	%	

TEMPERATURE SPECIFICATIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
TEMPERATURE RANGE						
Operating Ambient Temperature Range	T_A	–25	—	+85	°C	
Storage Temperature Range	T_S	–65	—	+150	°C	
PACKAGE THERMAL RESISTANCE						
8-lead SOIC	θ_{JA}	—	101	—	°C/W	

2.0 PIN DESCRIPTION

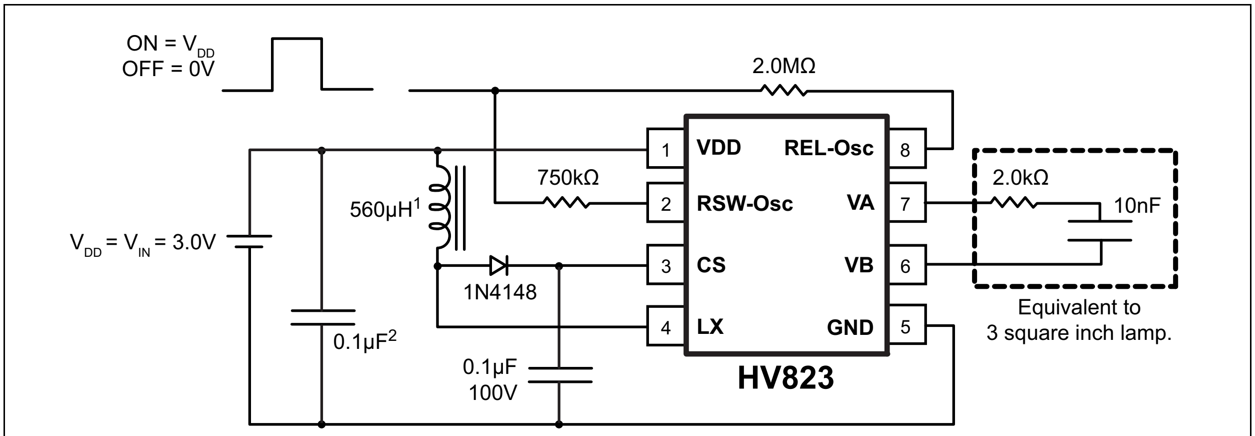
The details on the pins of HV823 are listed in Table 2-1.
See location of pins in Package Type.

TABLE 2-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	VDD	Input supply pin
2	RSW-Osc	The switching frequency of the converter is controlled via an external resistor, R_{SW}, between the RSW-Osc and VDD pins of the device. The switching frequency increases as the R_{SW} decreases. With a given inductor, as the switching frequency increases, the amount of current drawn from the battery decreases and the output voltage, V_{CS}, also decreases.
		A 1 nF capacitor is recommended on RSW-Osc pin to GND when a 0.01 µF C_S capacitor is used. This capacitor is used to shunt any switching noise that may couple into the RSW-Osc pin. The C_{SW} capacitor may also be needed when driving large EL lamp due to increase in switching noise. A C_{SW} larger than 1 nF is not recommended.
3	CS	A fast recovery diode (1N4148 or equivalent) should be used here, and a 0.01 µF to 0.1 µF 100V capacitor to GND needs to be used to store the energy transferred from the inductor as indicated in Figure 3-1.
4	LX	The inductor LX is used to boost the low input voltage by inductive flyback. When the internal switch is on, the inductor is being charged. When the internal switch is turned off, the charge stored in the inductor will be transferred to the high-voltage capacitor C_S. The energy stored in the capacitor is connected to the internal H-bridge and therefore to the EL lamp. In general, smaller value inductors, which can handle more current, are more suitable to drive larger size lamps. As the inductor value decreases, the switching frequency of the inductor (controlled by R_{SW}) should be increased to avoid saturation. 560 µH inductors with 14.5Ω series DC resistance is typically recommended. For inductors with the same inductance value but with lower series DC resistance, lower R_{SW} value is needed to prevent high current draw and inductor saturation.
5	GND	Ground pin
6,7	VA, VB	The EL lamp terminals are connected to the VA and VB pins. Polarity is irrelevant. As the EL lamp size increases, more current will be drawn from the battery to maintain high voltage across the EL lamp. The input power, (V_{IN} x I_{IN}), will also increase. If the input power is greater than the power dissipation of the package (400 mW), an external resistor in series with one side of the lamp is recommended to help reduce the package power dissipation.
8	REL-Osc	The EL lamp frequency is controlled via an external R_{EL} resistor connected between REL-Osc and VDD pins of the device. The lamp frequency increases as R_{EL} decreases. As the EL lamp frequency increases, the amount of current drawn from the battery increases and the output voltage V_{CS} decreases. The color of the EL lamp is dependent on its frequency. A 2 MΩ resistor would provide a lamp frequency of 330 Hz to 450 Hz. Decreasing the REL-Osc by a factor of two will increase the lamp frequency by a factor of two.

3.0 APPLICATION INFORMATION

3.1 Test Circuit V_{IN} = 3V



Note: For additional information, see *AN-H34* application note.

FIGURE 3-1: *Test Circuit, V_{IN} = 3V (Low-input Current with Moderate Output Brightness).*

TABLE 3-1: TYPICAL PERFORMANCE

Lamp Size	V_{IN}	I_{IN}	V_{CS}	f_{EL}	Brightness
3.0 in^2	3V	25 mA	65V	385 Hz	6.5 ft-lm

Note 1: Inductor with DC resistance <14.5Ω

2: Larger values may be required depending upon supply impedance.

3.1.1 TYPICAL PERFORMANCE CURVES FOR TEST CIRCUIT VIN = 3V USING 3 IN^2 EL LAMP

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g. outside specified power supply range) and therefore outside the warranted range.

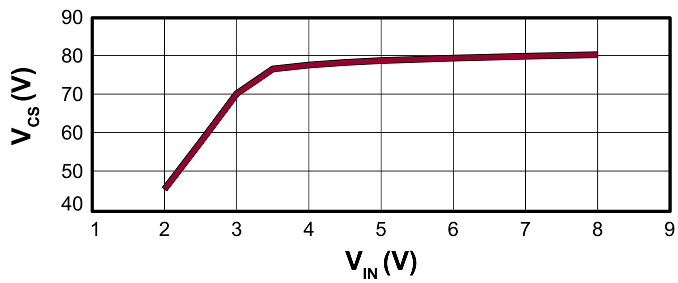


FIGURE 3-2: *V_{CS} vs. V_{IN}.*

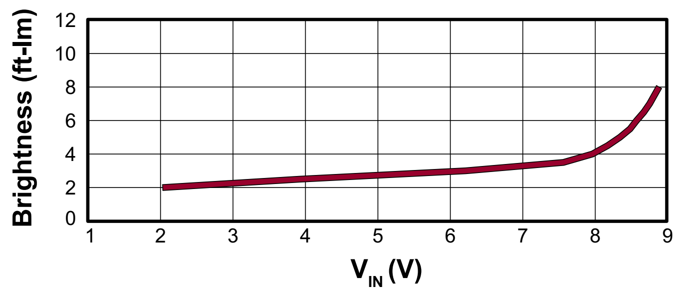


FIGURE 3-3: *Brightness vs. V_{IN}.*

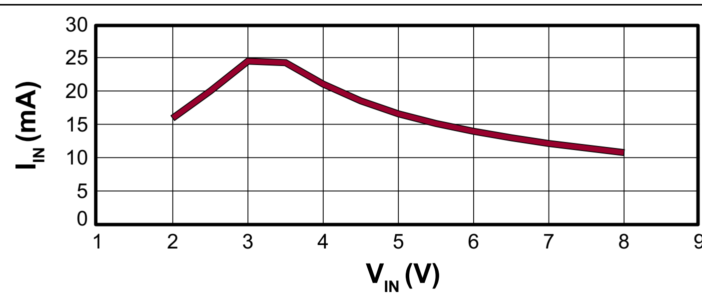


FIGURE 3-4: *I_{IN} vs. V_{IN}.*

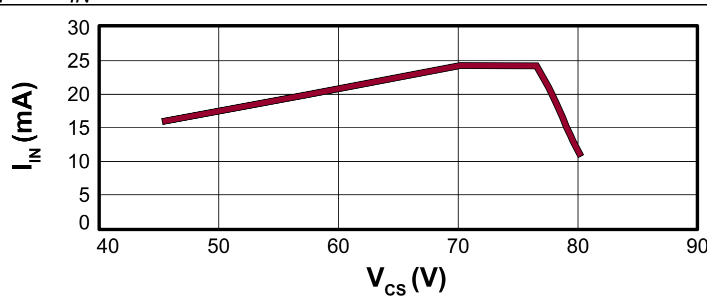


FIGURE 3-5: *I_{IN} vs. V_{CS} (V).*

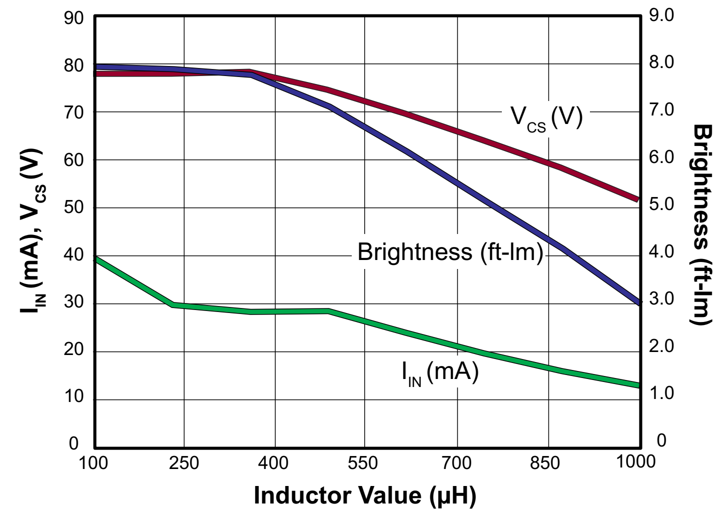
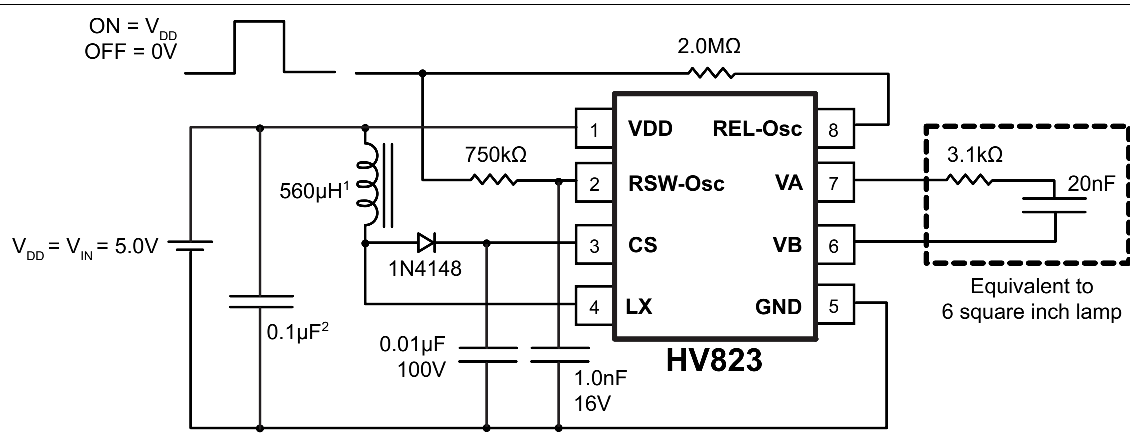


FIGURE 3-6: *I_{IN}, V_{CS} and Brightness vs. Inductor Value.*

3.2 Typical 5V Application



Note: For additional information, see *AN-H34* Application Note.

FIGURE 3-7: *Typical 5V Application.*

TABLE 3-2: TYPICAL PERFORMANCE

Lamp Size	V_{IN}	I_{IN}	V_{CS}	f_{EL}	Brightness
6 in^2	5V	25 mA	75V	380 Hz	6.5 ft-lm

Note 1: Inductor with DC resistance <14.5Ω

2: Larger values may be required depending upon supply impedance.

3.2.1 TYPICAL PERFORMANCE CURVES FOR A TYPICAL 5V APPLICATION

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g. outside specified power supply range) and therefore outside the warranted range.

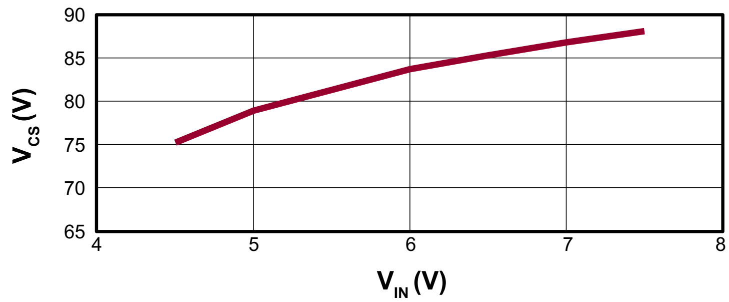


FIGURE 3-8: *V_{CS} vs. V_{IN}.*

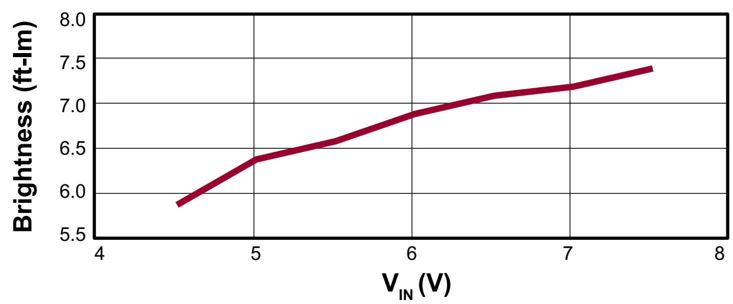


FIGURE 3-9: *Brightness vs. V_{IN}.*

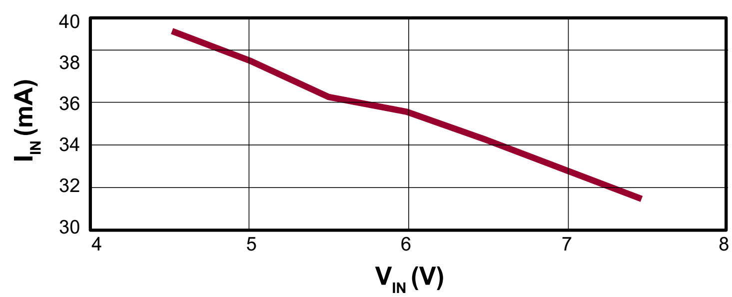


FIGURE 3-10: *I_{IN} vs. V_{IN}.*

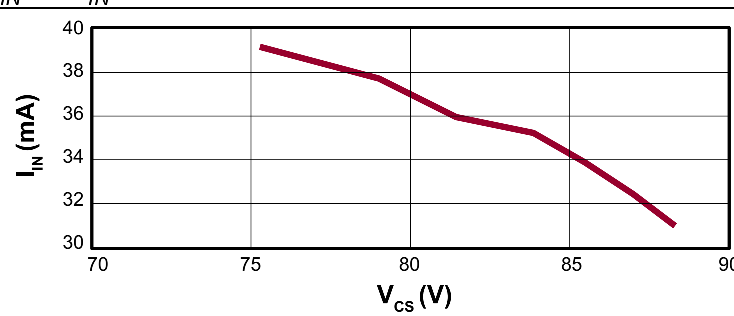
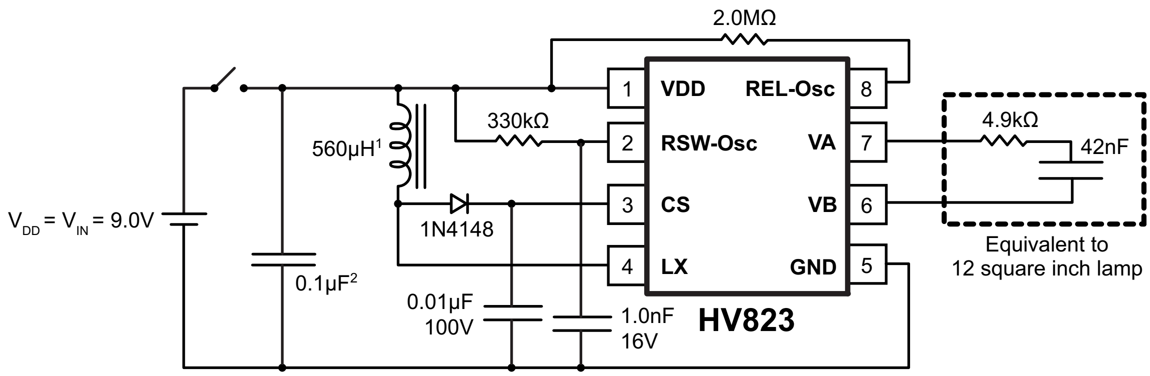


FIGURE 3-11: *I_{IN} vs. V_{CS}.*

3.3 Typical 9V Application



Note: For additional information, see *AN-H34 Application Note*.

FIGURE 3-12: *Typical 9V Application.*

TABLE 3-3: TYPICAL PERFORMANCE

Lamp Size	V_{IN}	I_{IN}	V_{CS}	f_{EL}	Brightness
12 in^2	9V	30 mA	75V	380 Hz	6.5 ft-lm

Note 1: Inductor with DC resistance < 14.5Ω.

2: Larger values may be required depending upon supply impedance.

3.3.1 TYPICAL PERFORMANCE CURVES FOR A TYPICAL 9V APPLICATION

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g. outside specified power supply range) and therefore outside the warranted range.

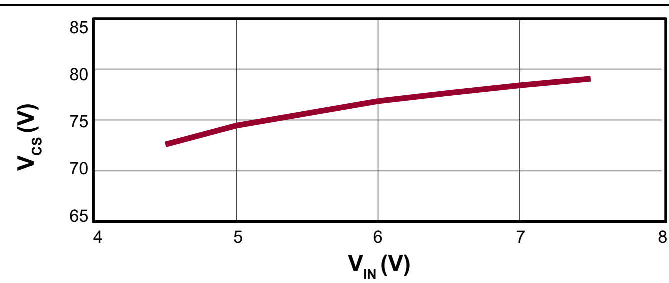


FIGURE 3-13: *V_{CS} vs. V_{IN}.*

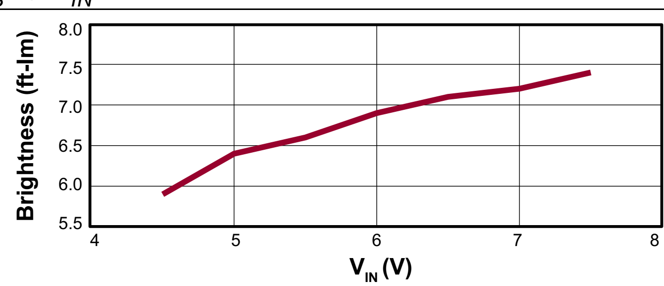


FIGURE 3-14: *Brightness vs. V_{IN}.*

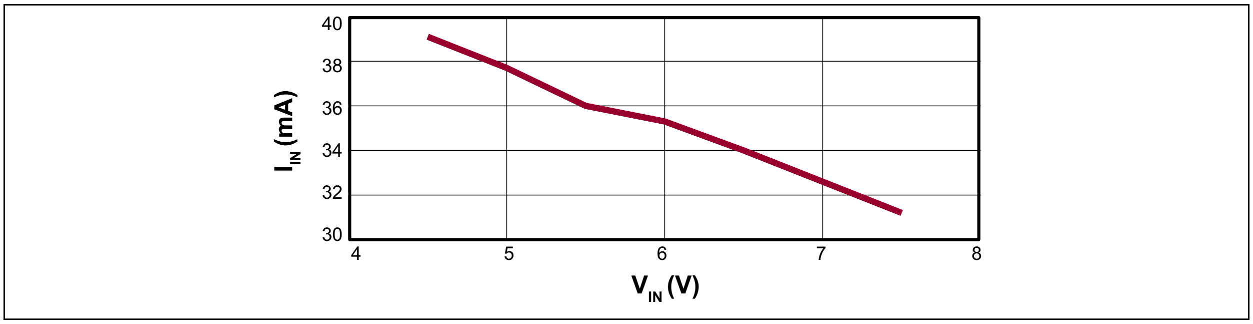


FIGURE 3-15: *I_{IN} vs. V_{IN}.*

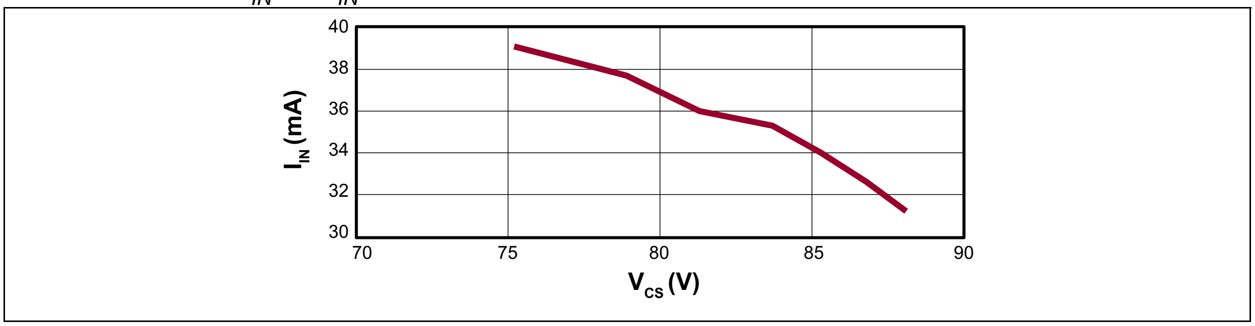


FIGURE 3-16: *I_{IN} vs. V_{CS} (V).*

3.4 Enable/Disable Configuration

The HV823 can be easily enabled and disabled via a logic control signal on the R_{SW} and R_{EL} resistors as shown in Figure 3-17. The control signal can be from a microprocessor. R_{SW} and R_{EL} are typically very high values. Therefore, only 10s of microamperes will be drawn from the logic signal when it is at a logic High (enable) state. When the microprocessor signal is high the device is enabled, and when the signal is logic low, it is disabled.

TABLE 3-4: ENABLE/DISABLE

R_{SW} Resistor	HV823
V_{DD}	Enable
0V	Disable

3.5 Split Supply Configuration Using a Single Cell (1.5V) Battery

The HV823 can also be used for handheld devices operating from a single cell 1.5V battery where a regulated voltage is available. This is shown in Figure 3-18. The regulated voltage can be used to run the internal logic of the HV823. The amount of current necessary to run the internal logic is typically 100 µA at a V_{DD} of 3V. Therefore, the regulated voltage could easily provide the current without being loaded down. The HV823 used in this configuration can also be enabled/disabled via logic control signal on the R_{SW} and R_{EL} resistors as shown in Figure 3-17.

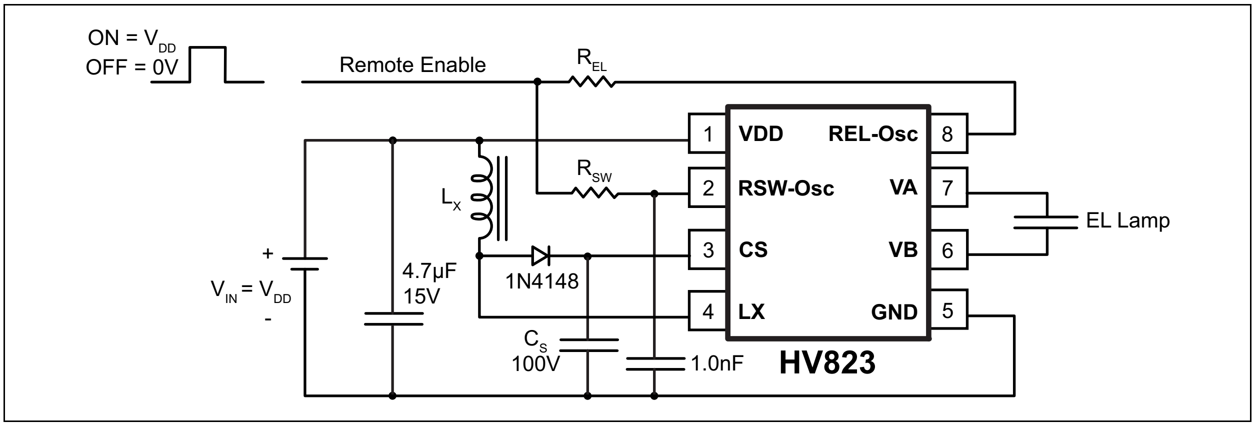


FIGURE 3-17: *Enable/Disable Configuration.*

3.6 Split Supply Configuration for Battery Voltages of Higher than 9.5V

Figure 3-18 can also be used with high battery voltages, such as 12V, as long as the input voltage, V_{DD}, to the HV823 device is within its specifications of 2V to 9.5V.

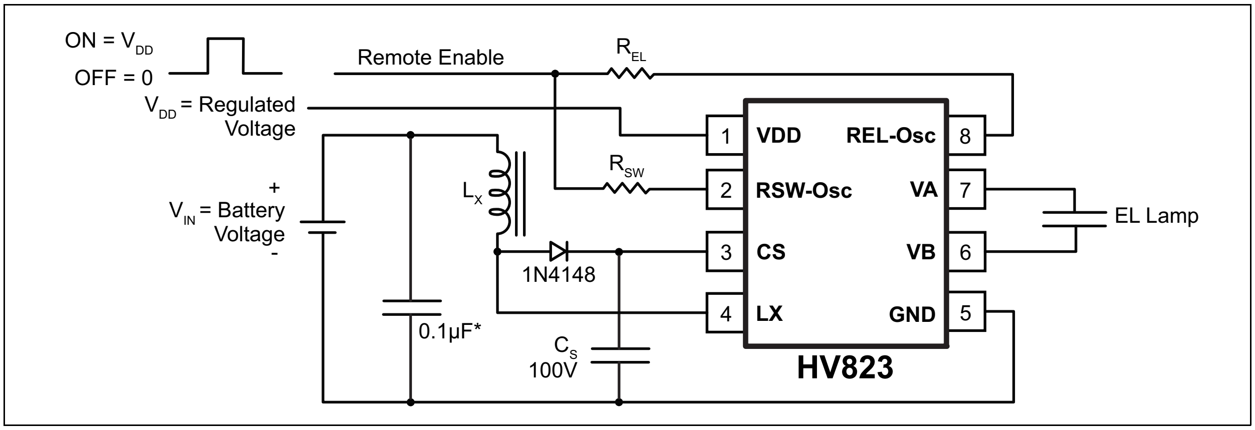
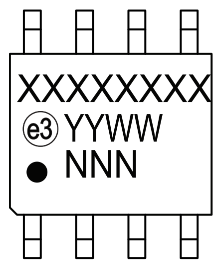


FIGURE 3-18: *Split Supply Configuration.*

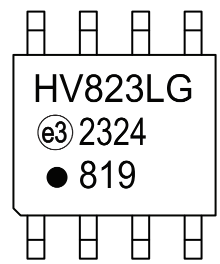
4.0 PACKAGING INFORMATION

4.1 Package Marking Information

8-lead SOIC



Example

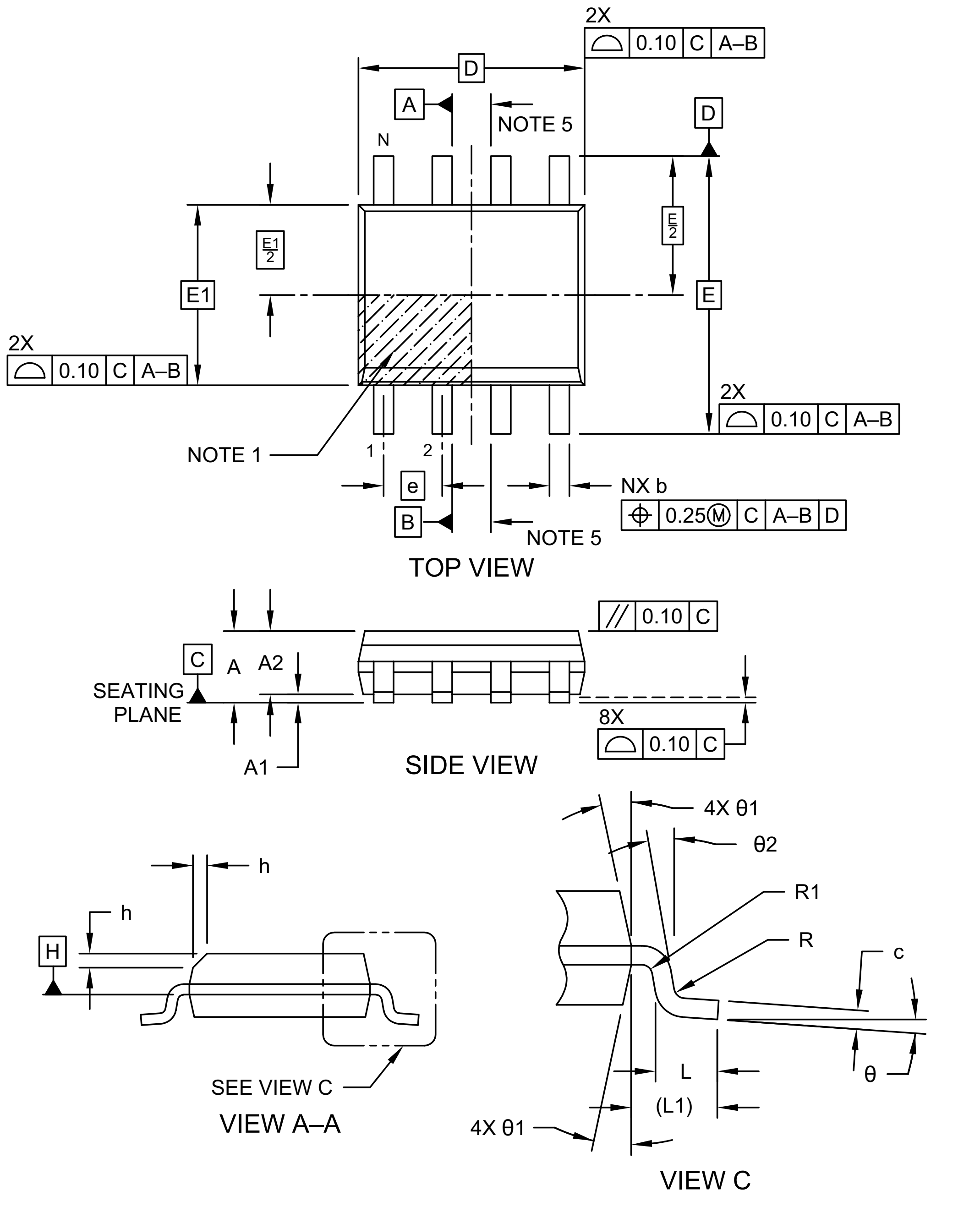


Legend:	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.

Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for product code or customer-specific information. Package may or not include the corporate logo.

8-Lead Plastic Small Outline (C2X) - Narrow, 3.90 mm (.150 In.) Body [SOIC]
Atmel Legacy Global Package Code SWB

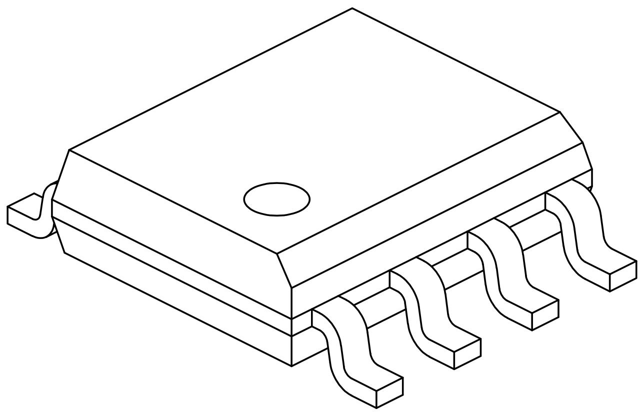
Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing No. C04-057-C2X Rev K Sheet 1 of 2

8-Lead Plastic Small Outline (C2X) - Narrow, 3.90 mm (.150 In.) Body [SOIC]
Atmel Legacy Global Package Code SWB

Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	1.27 BSC		
Overall Height	A	–	–	1.75
Molded Package Thickness	A2	1.25	–	-
Standoff §	A1	0.10	–	0.25
Overall Width	E	6.00 BSC		
Molded Package Width	E1	3.90 BSC		
Overall Length	D	4.90 BSC		
Chamfer (Optional)	h	0.25	–	0.50
Foot Length	L	0.40	–	1.27
Footprint	L1	1.04 REF		
Lead Thickness	c	0.17	–	0.25
Lead Width	b	0.31	–	0.51
Lead Bend Radius	R	0.07	–	–
Lead Bend Radius	R1	0.07	–	–
Foot Angle	θ	0°	–	8°
Mold Draft Angle	θ1	5°	–	15°
Lead Angle	θ2	0°	–	–

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M

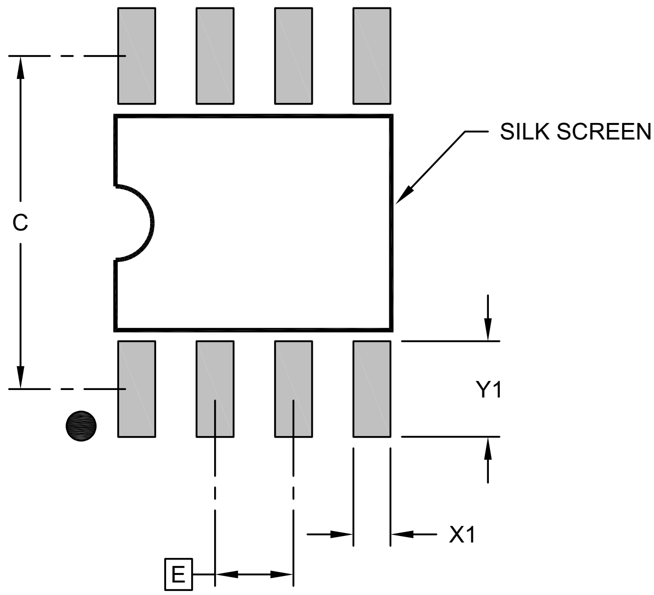
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.
5. Datums A & B to be determined at Datum H.

Microchip Technology Drawing No. C04-057-C2X Rev K Sheet 2 of 2

8-Lead Plastic Small Outline (C2X) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		1.27 BSC	
Contact Pad Spacing	C		5.40	
Contact Pad Width (X8)	X1			0.60
Contact Pad Length (X8)	Y1			1.55

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-2057-C2X Rev K

APPENDIX A: REVISION HISTORY

Revision A (July 2023)

- Converted Supertex Doc# DSFP-HV823 to Microchip DS20005634A
- Removed reference to HVCMOS® Technology
- Changed the quantity of the K6 package from 3000/Reel to 3300/Reel to align packaging specifications with the actual BQM
- Updated package outline drawing
- Made minor text changes throughout the document

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

PART NO.	XX	-	X	-	X
Device	Package Options		Environmental		Media Type

Device:	HV823	=	High-Voltage EL Lamp Driver IC
Packages:	LG	=	8-lead SOIC
Environmental:	G	=	Lead (Pb)-free/RoHS-compliant Package
Media Type:	(blank)	=	3300/Reel for an LG Package

Example:

a) HV823LG-G: High-Voltage EL Lamp Driver IC, 8-lead SOIC Package, 3300/Reel

ISBN: 978-1-6683-2825-5

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