

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

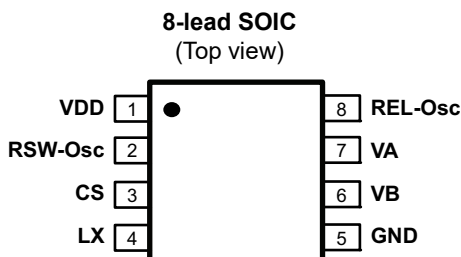
The HV823 is a high-voltage driver designed for driving Electroluminescent (EL) lamps of up to 50 nF. EL lamps greater than 50 nF can be driven for applications not requiring high brightness. The input supply voltage range is from 2V to 9.5V. The device uses a single inductor and a minimum number of passive components. The nominal regulated output voltage that is applied to the EL lamp is $\pm 90V$. 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 VDD supply pin. The EL lamp driver frequency is set by an external resistor connected between the REL-Osc pin and the VDD pin. An external inductor is connected between the LX pin and the VDD pin. A 0.01 μF to 0.1 μF capacitor is connected between the CS 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 CS capacitor. The voltage at CS will start to increase. Once the voltage at CS reaches a nominal value of 90V, the switching MOSFET is turned OFF to conserve power. The output pins VA and VB 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.

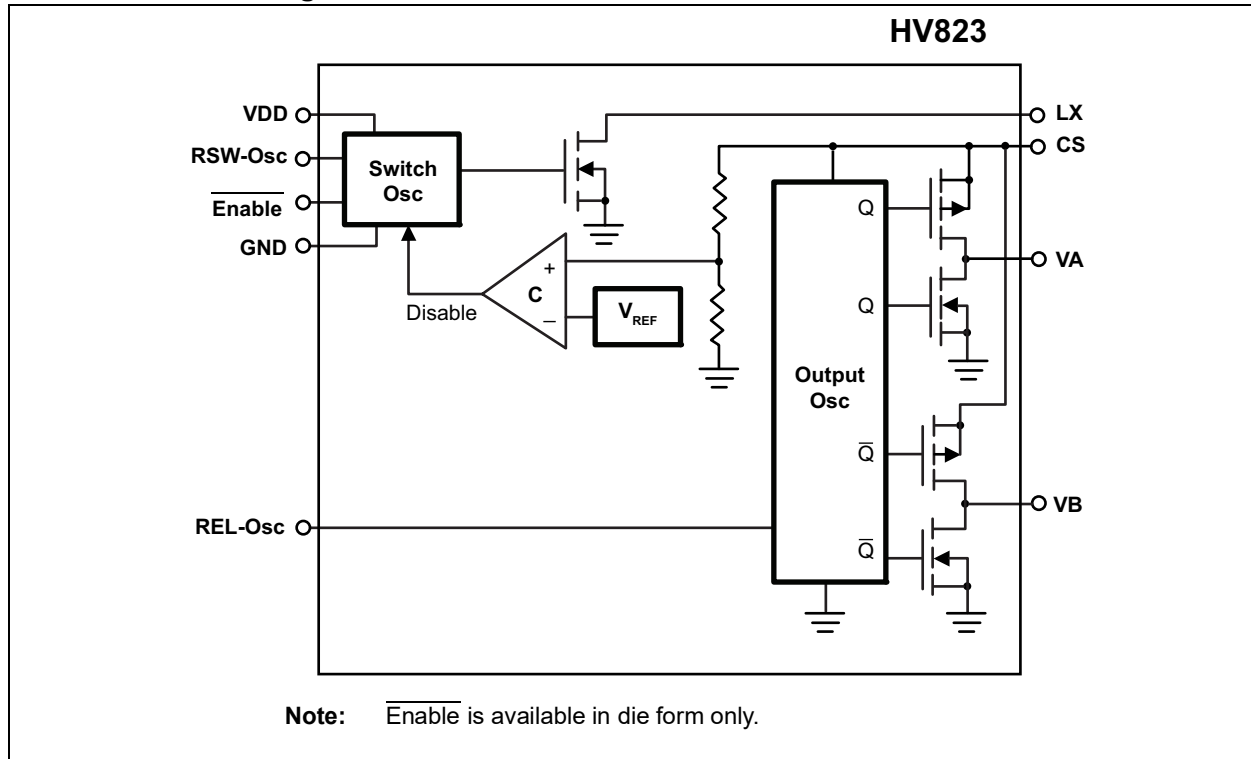
Package Type



See [Table 2-1](#) for pin information.

HV823

Functional Block Diagram



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: $V_{IN} = 3V$, $R_{SW} = 750\text{ K}\Omega$, $R_{EL} = 2\text{ M}\Omega$, $T_A = 25^\circ\text{C}$ unless otherwise specified.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
On Resistance of Switching Transistor	$R_{DS(ON)}$	—	2	6	Ω	$I = 100\text{ mA}$
Output Voltage V_{CS} Regulation	V_{CS}	80	90	100	V	$V_{IN} = 2V\text{ to }9.5V$
Output Peak-to-Peak Voltage	$V_A - V_B$	160	180	200	V	$V_{IN} = 2V\text{ to }9.5V$
Quiescent V_{DD} Supply Current, Disabled	I_{DDQ}	—	30	100	nA	$R_{SW-OSC} = \text{Low}$
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	—	%	

HV823

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 μ F to 0.1 μ F 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 μ H inductors with 14.5 Ω 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, ($V_{IN} \times I_{IN}$), 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 M Ω 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 $V_{IN} = 3V$

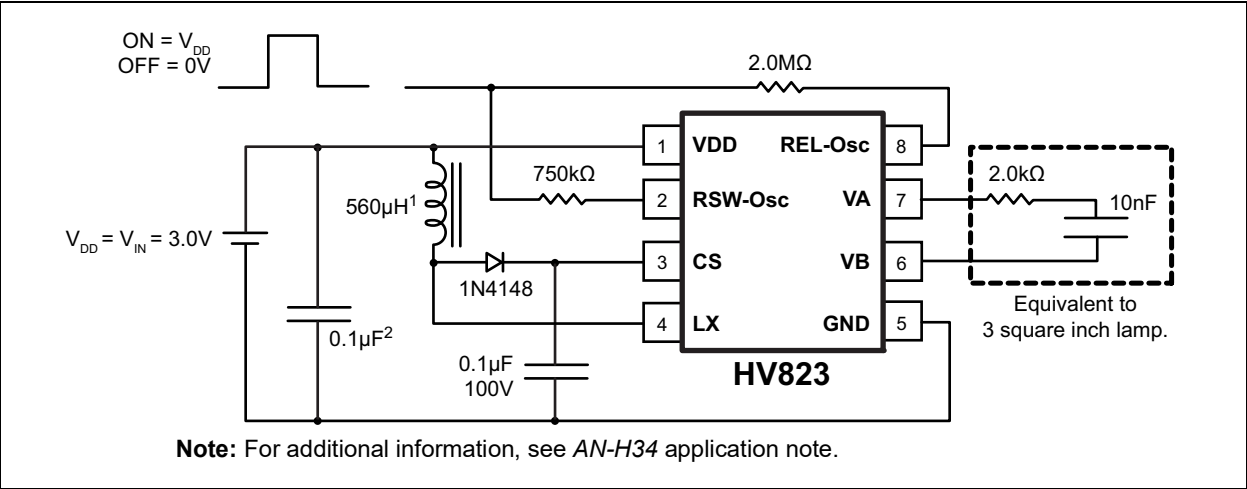


FIGURE 3-1: Test Circuit, $V_{IN} = 3V$ (Low-input Current with Moderate Output Brightness).

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

3.1.1 TYPICAL PERFORMANCE CURVES FOR TEST CIRCUIT VIN = 3V USING 3 IN² 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.

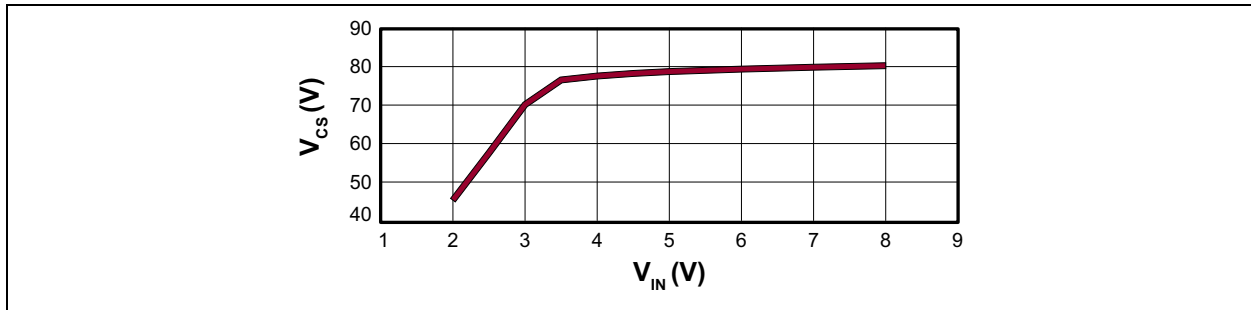


FIGURE 3-2: V_{CS} vs. V_{IN}.

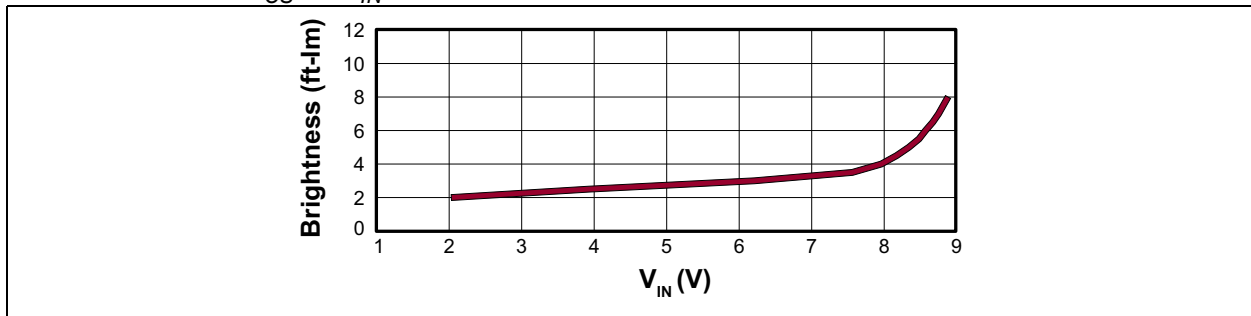


FIGURE 3-3: Brightness vs. V_{IN}.

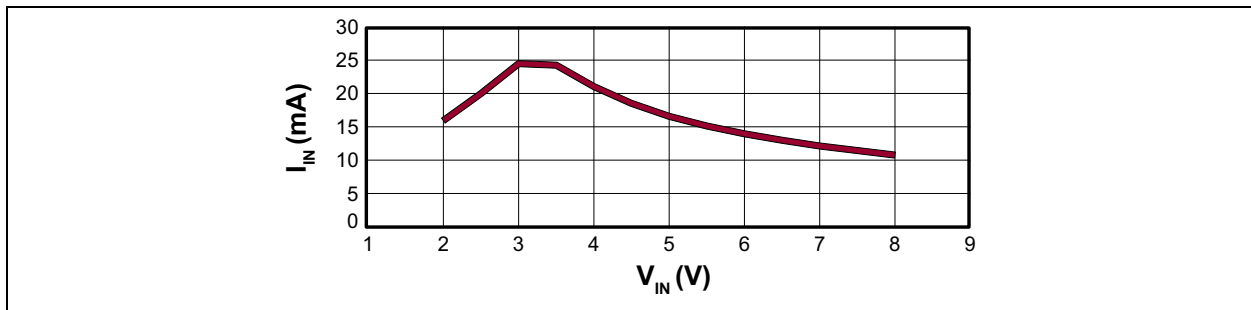


FIGURE 3-4: I_{IN} vs. V_{IN}.

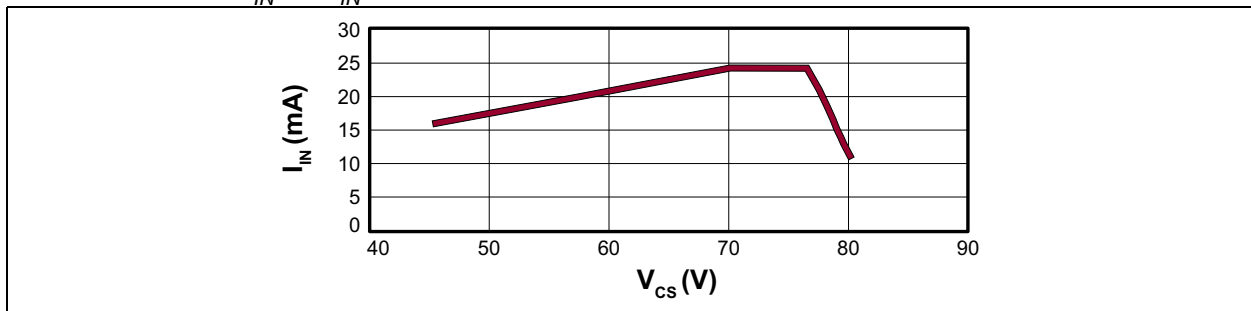


FIGURE 3-5: I_{IN} vs. V_{CS} (V).

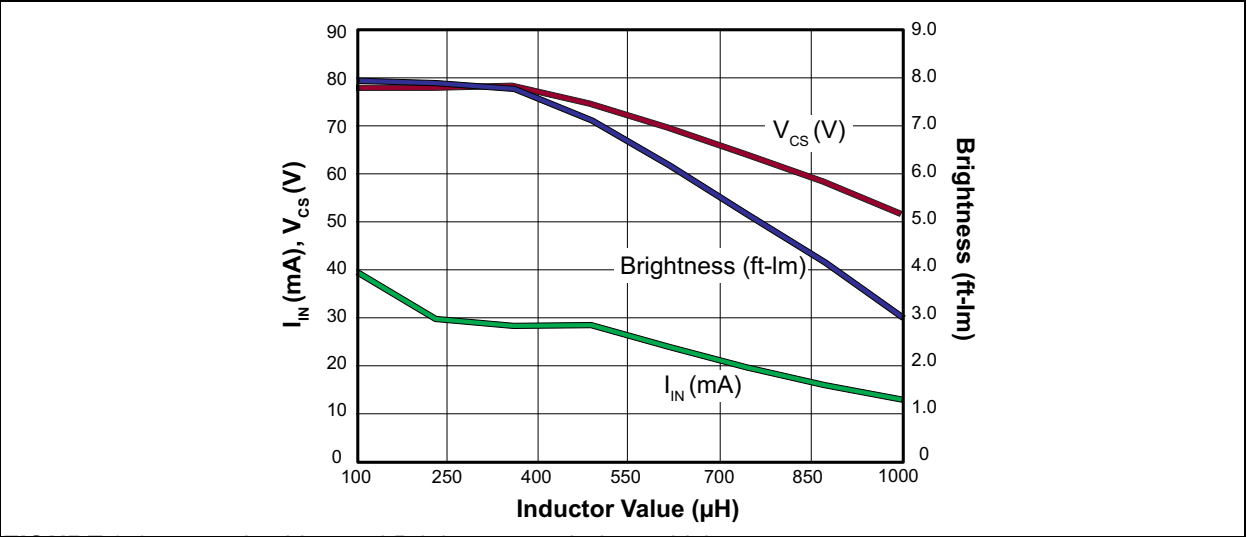
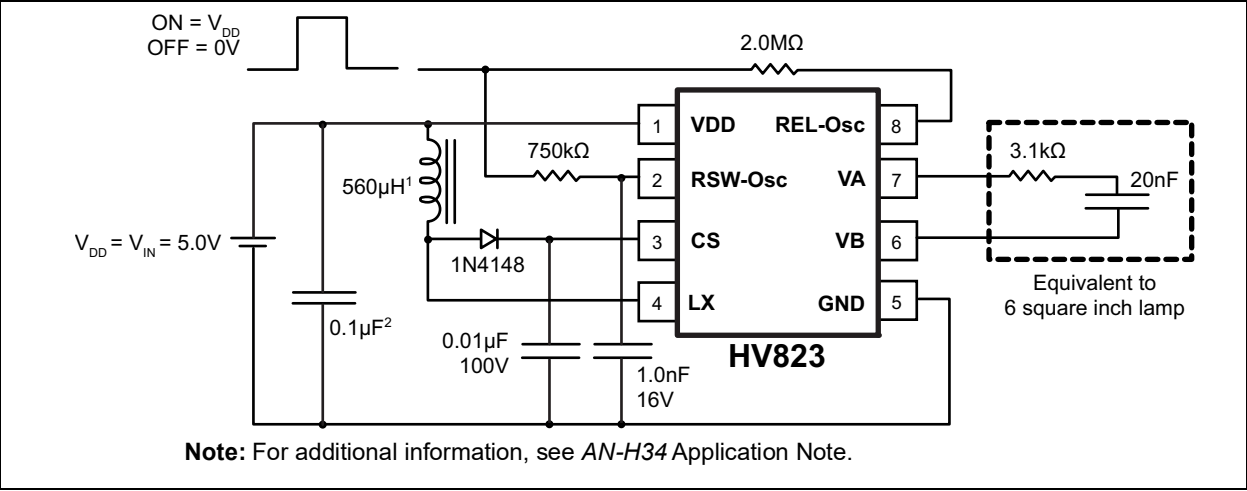


FIGURE 3-6: I_{IN} , V_{CS} and Brightness vs. Inductor Value.

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.

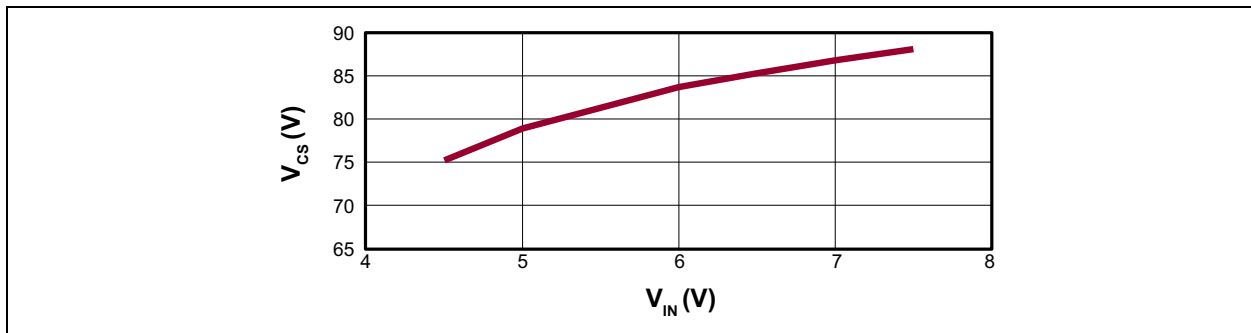


FIGURE 3-8: V_{CS} vs. V_{IN} .

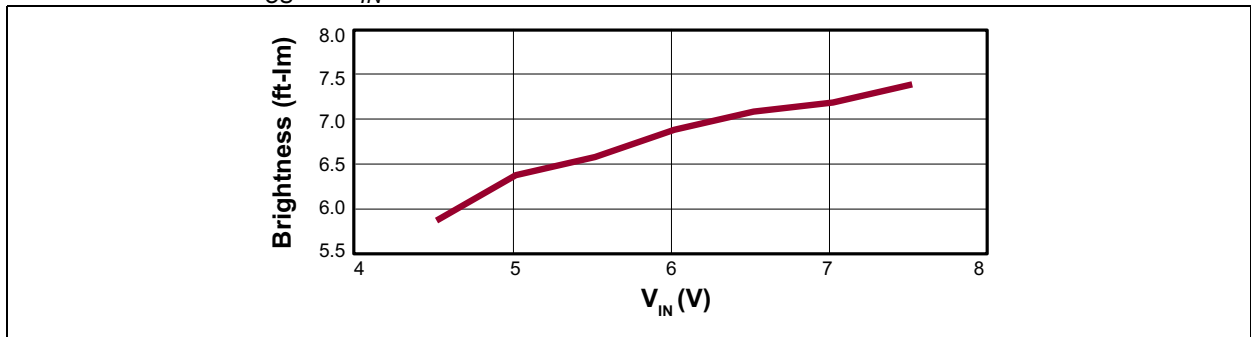


FIGURE 3-9: Brightness vs. V_{IN} .

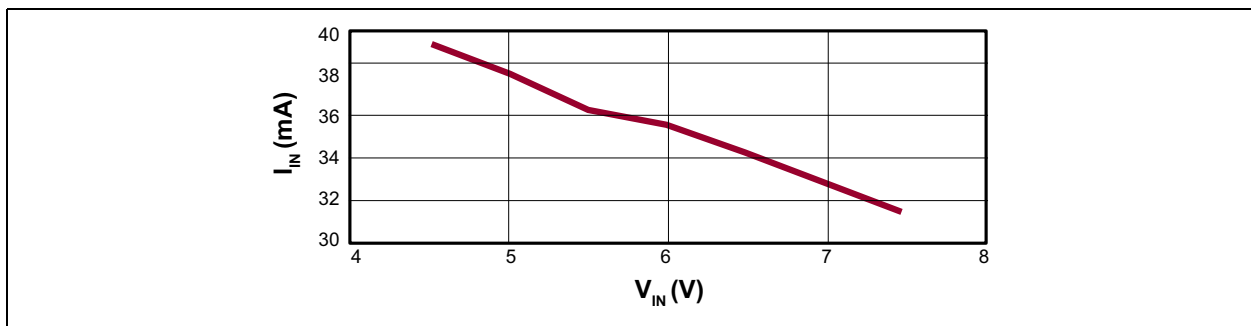


FIGURE 3-10: I_{IN} vs. V_{IN} .

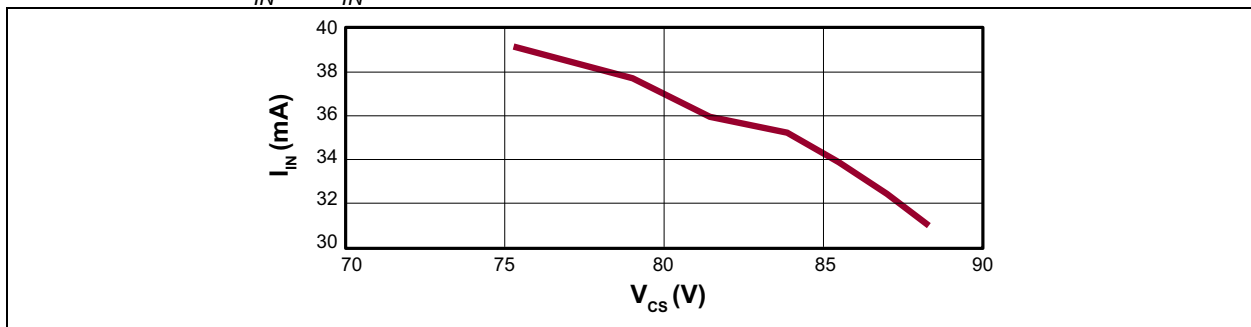


FIGURE 3-11: I_{IN} vs. V_{CS} .

HV823

3.3 Typical 9V Application

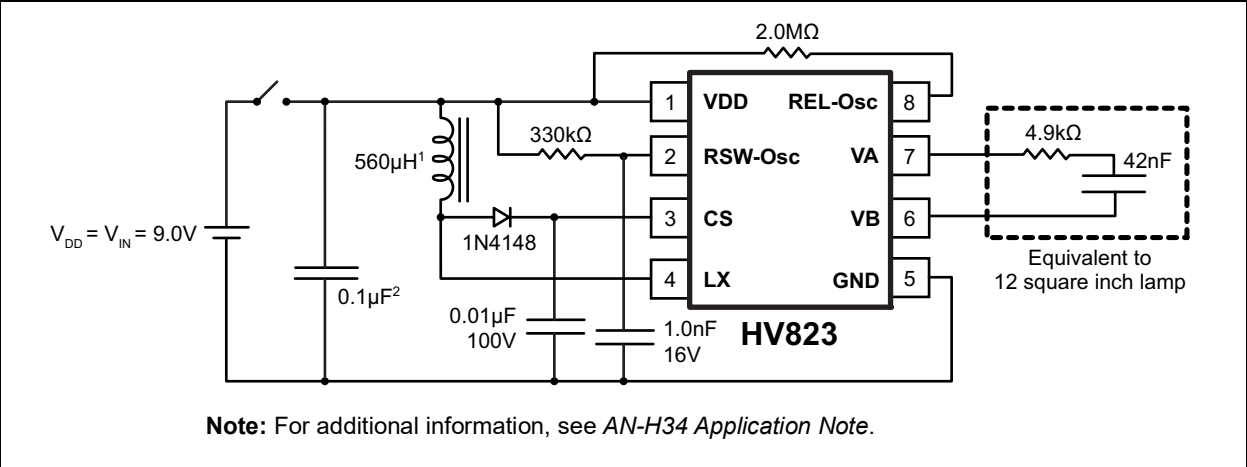


FIGURE 3-12: Typical 9V Application.

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.
Note 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.

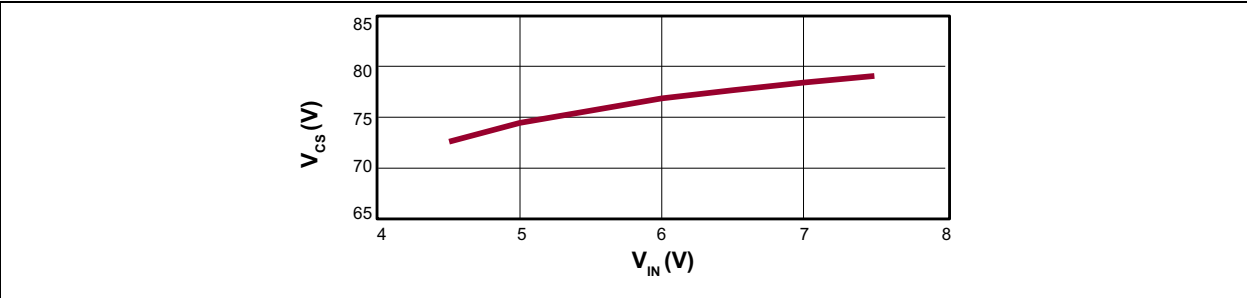


FIGURE 3-13: V_{CS} vs. V_{IN}.

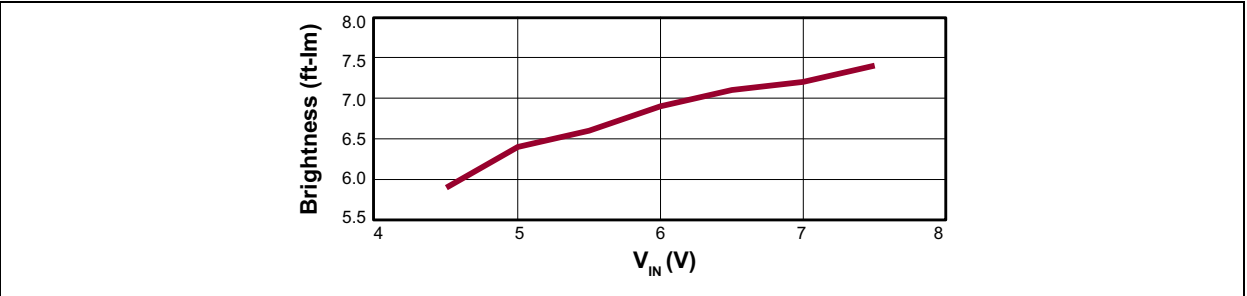


FIGURE 3-14: Brightness vs. V_{IN}.

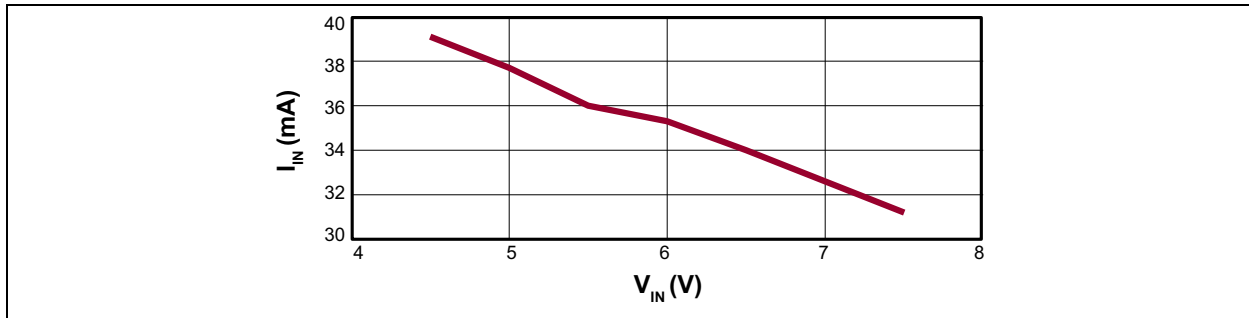


FIGURE 3-15: I_{IN} vs. V_{IN} .

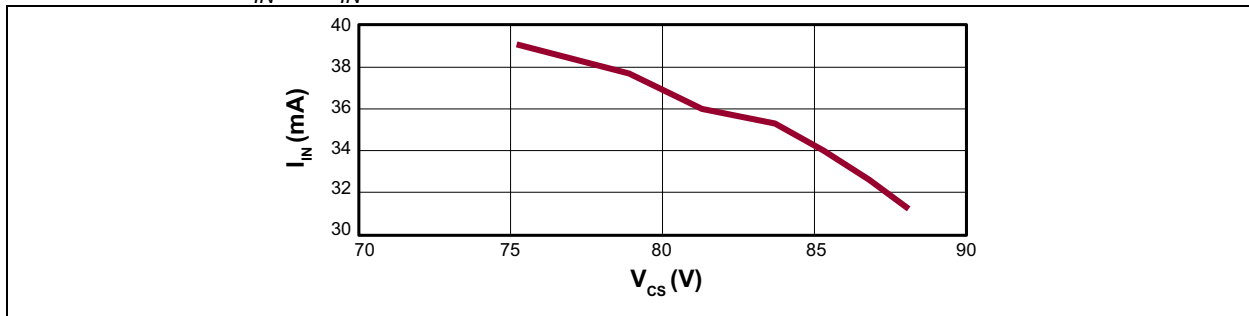


FIGURE 3-16: I_{IN} vs. V_{CS} (V).

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.



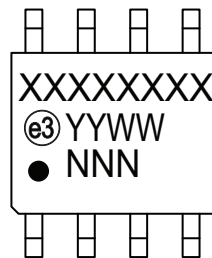
Figure 3-18 can also be used with high battery voltages, such as 12V, as long as the input voltage, V_{DD} , to the HV823 device is within its specifications of 2V to 9.5V.



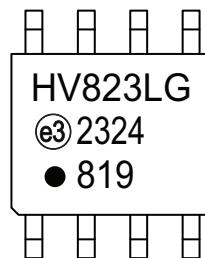
4.0 PACKAGING INFORMATION

4.1 Package Marking Information

8-lead SOIC



Example

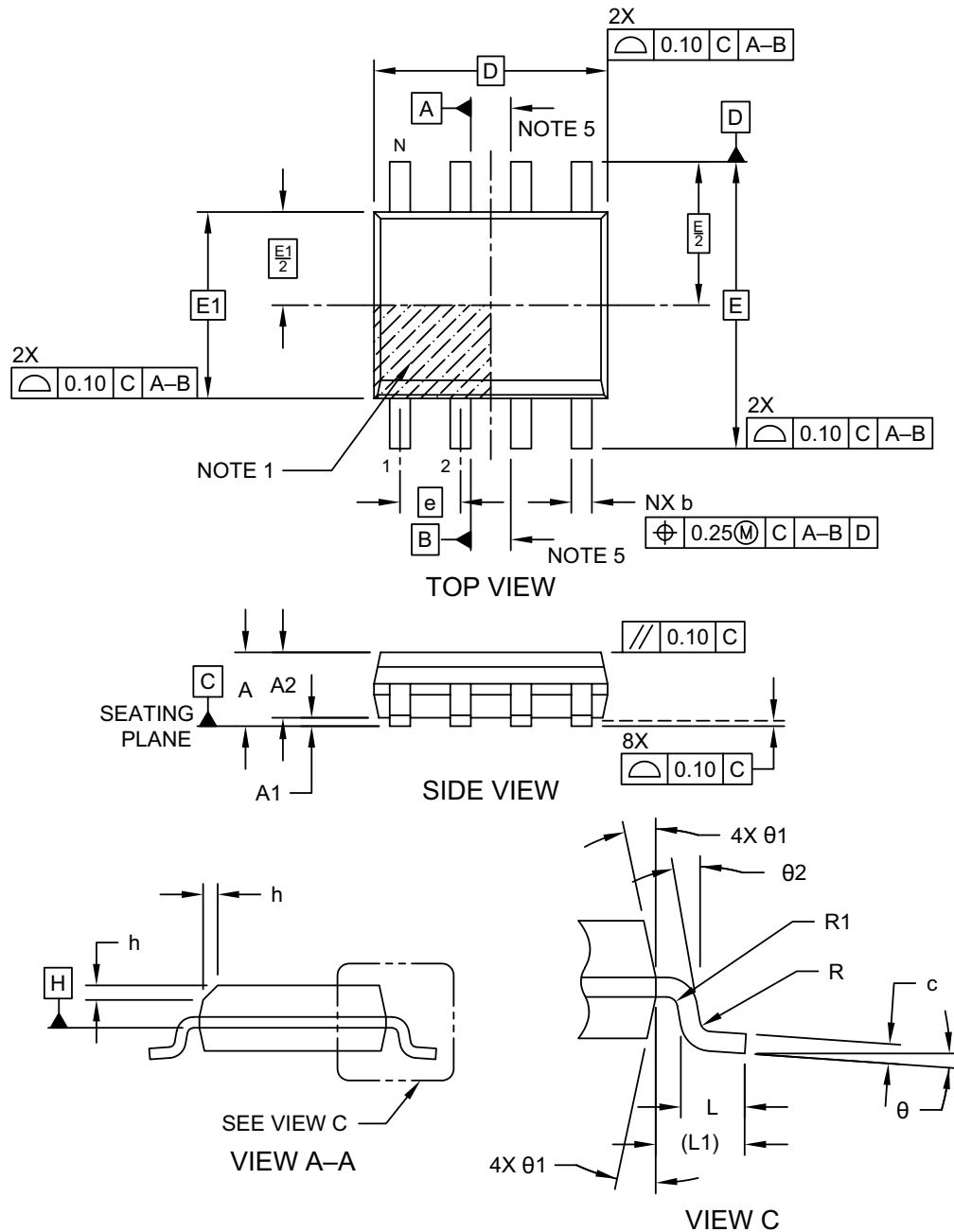


Legend:	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	e3	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is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

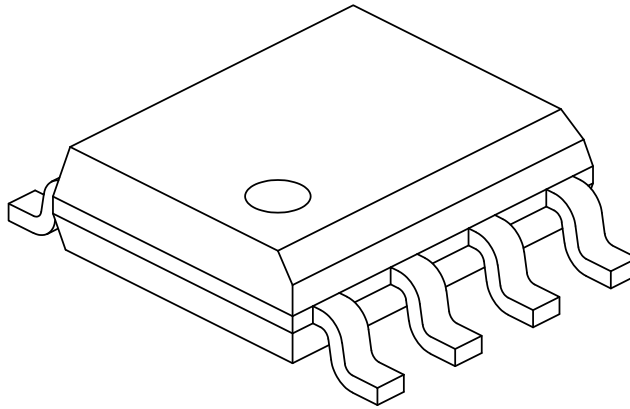
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



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>



Dimension Limits	Units	MILLIMETERS		
		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°	–	–

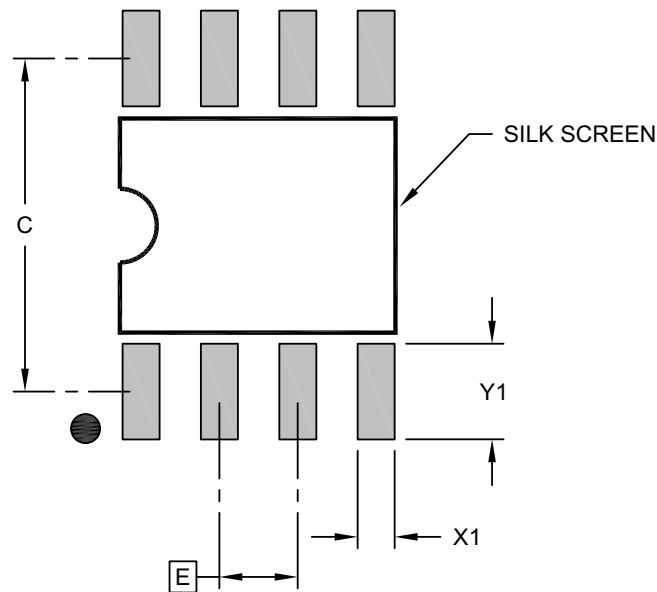
Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm per side.
- 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.
- 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.

<u>PART NO.</u>		<u>XX</u>	-	<u>X</u>	-	<u>X</u>
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

Note the following details of the code protection feature on Microchip products:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
 - Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
 - Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
 - Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable" Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.
-

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. Contact your local Microchip sales office for additional support or, obtain additional support at <https://www.microchip.com/en-us/support/design-help/client-support-services>.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Klear, LANCheck, LinkMD, maxStylus, maxTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, Flashtec, Hyper Speed Control, HyperLight Load, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, TrueTime, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, Clockstudio, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, GridTime, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, IntelliMOS, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, KoD, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICKit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQL, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, Trusted Time, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, and Symmcom are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2023, Microchip Technology Incorporated and its subsidiaries.

All Rights Reserved.

ISBN: 978-1-6683-2825-5

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
<http://www.microchip.com/support>
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX
Tel: 512-257-3370

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Novi, MI
Tel: 248-848-4000

Houston, TX
Tel: 281-894-5983

Indianapolis
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC
Tel: 919-844-7510

New York, NY
Tel: 631-435-6000

San Jose, CA
Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto
Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-3326-8000

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
Tel: 86-186-6233-1526

China - Wuhan
Tel: 86-27-5980-5300

China - Xian
Tel: 86-29-8833-7252

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-4121-0141

Japan - Osaka
Tel: 81-6-6152-7160

Japan - Tokyo
Tel: 81-3-6880-3770

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

Malaysia - Penang
Tel: 60-4-227-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600

Thailand - Bangkok
Tel: 66-2-694-1351

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4485-5910
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-72400

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7288-4388

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820