Electroluminescent Lamp Drivers
EL Lamp Applications

- Pagers
- Caller ID
- Appliances
- Telephones
- Thermostats
- Weight Scales
- Cellular Phones
- Digital Compasses
- HPCs (Handheld PCs)
- Temperature Monitors
- Automotive Dashboards
- GPS Handheld Receivers
- PDAs (Personal Digital Assistants)
- Watches and Alarm Clocks
- Test and Medical Equipment
- TV/VCR/Audio/Cable Box Remote Controllers
IMP, Inc. - Company Profile

IMP, Inc. designs, manufacturers and markets standard-setting analog integrated circuits and specialty analog wafer foundry processes for data communications interface and power management applications in computer, communications and control systems. IMP products are sold through a worldwide network of representatives and distributors.

Company Facilities

IMP headquarters and ISO 9001 certified wafer fabrication and test facility are located in San Jose, California. A product development center is located in Pleasanton, California. The company employs 188 people.

Principal Markets

Data Communications Interface – Data communications components, such as PCM digital switch and Small Computer Systems Interface (SCSI) terminator integrated circuits.

Power Management – Devices to generate, distribute, protect and manage thermal and power consumption characteristics of desktop and portable computers, mobile and wireless communication devices, and battery powered electronic systems. Example products include electroluminescent lamp drivers, Universal Serial Bus (USB) power switches, microprocessor supervisors, low dropout voltage regulators, and high-frequency switching converters.

Wafer Fabrication and Manufacturing Services

High-volume, analog and mixed-signal wafer foundry services on low-power, high-voltage, CMOS, BiCMOS, Bipolar and EEPROM processes, including turnkey packaging and test capabilities. Fabrication services include database production using IMP standard processes, process development and porting of customer-owned technology.

For More Information

Visit the IMP web site at www.impweb.com; email info@impinc.com or contact IMP headquarters at 408.432.9100.
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IMP Electroluminescent Lamp Drivers

IMP electroluminescent lamp drivers incorporate four EL lamp driving functions on-chip. These are the boost switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. Few external components are needed: one inductor, one diode, one capacitor and two resistors. The resistors allow independent adjustment of boost converter frequency and EL lamp drive frequency. Adjustable lamp drive frequency allows control over lamp color and power dissipation. All devices can be disabled for power saving.

All devices are available in chip form and small MicroSO and SO packages. Tape and reel shipment is available without additional cost.
**IMP525: Single Cell Battery Powered Electroluminescent Lamp Driver/Inverter**

The IMP525 Electroluminescent (EL) lamp driver is designed for systems that must operate down to 1V and below. The input supply voltage range is 0.9V to 2.5V. Typical output lamp drive voltage is 112V peak-to-peak. EL lamps of up to 6nF capacitance can be driven to high brightness.

A disable mode puts the chip into a low current-drain state. When disabled, quiescent current drops to 1µA typical with a VDD of 1.5V. Connecting RSVP, the oscillator frequency setting resistor, to ground, can disable the chip. A disable pad, accessible only on the die, can also be used to disable the driver (active low). An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 112V peak-to-peak. This conserves power and extends battery life.

### Key Features
- **Wide operating voltage range** - from 0.9V to 2.5V
- **Simple design requires few passive components**
- **112V peak-to-peak typical AC output voltage**
- **Adjustable output frequency controls lamp color and power consumption**
- **Adjustable converter frequency minimizes circuit power consumption**
- **Disable mode extends battery life**
- **Disable current 1µA typical**
- **Compact MicroSO package and die option**
- **Same pinout as IMP803**
The IMP527 is an Electroluminescent (EL) lamp driver designed for systems that must operate down to 1 volt and below. The input supply voltage range is 0.9V to 2.5V. Typical output lamp drive voltage is 180V. All four EL lamp-driving functions are on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. EL lamps of up to 6nF capacitance can be driven to high brightness.

The circuit requires few external components; one inductor, one diode, one capacitor and two resistors. The resistors set the frequency for the two oscillators.

A disable mode puts the chip into a low current-drain state. When disabled, quiescent current drops to 1µA typical with a VDD of 1.5V. The chip can be disabled by connecting RSW, the oscillator frequency setting resistor, to ground. A disable pad (active low), accessible only on the die, can also be used to disable the driver.

An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 180V peak-to-peak. This conserves power and extends battery life.

The IMP527 is available in MicroSO and SO-8 packages and in die form.

Key Features
- Wide operating voltage range - from 0.9V to 2.5V
- Simple design requires few passive components
- 180V peak-to-peak typical AC output voltage
- Adjustable output frequency controls lamp color and power consumption
- Adjustable converter frequency minimizes circuit power consumption
- Disable mode extends battery life
- Disable current 1µA typical
- Compact MicroSO package option

---

The IMP528 is an Electroluminescent (EL) lamp driver with the four EL lamp driving functions on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. The IMP528 drives EL lamps of up to 50nF capacitance to high brightness; EL lamps with capacitances greater than 50nF can be driven, but will be lower in light output. The typical regulated output voltage that is applied to the EL lamp is 220V peak-to-peak. The circuit requires few external components; a single inductor, single diode, two capacitors and three resistors. Two of these resistors set the frequency for two internal oscillators.

Unlike other EL lamp drivers, the IMP528 does not require an external protection resistor in series with the EL lamp.

The IMP528 operates over a 2.0V to 6.5V supply voltage range. A regulated, low-power source can supply the low quiescent current of the IMP528. The inductor may be driven from an independent, unregulated supply voltage in dual supply applications.

An internal circuit shuts down the switching regulator when the lamp drive voltage reaches 220V peak-to-peak. This conserves power and extends battery life.

The IMP528 is available in MicroSO and SO-8 packages and in die or wafer form.

Key Features
- 220V peak-to-peak typical AC output voltage
- Low Power: 420µA typical VDD current
- Wide operating voltage range - from 2.0V to 6.5V
- Large output load capability - drives lamps with more than 50nF capacitance
- Eliminates external protection resistor in series with EL lamp
- Adjustable output lamp frequency for control of lamp color, lamp life, and power consumption
- Adjustable converter frequency to minimize power consumption
- High-Voltage CMOS Process
- MicroSO package option
IMP560: Power Efficient EL Lamp Driver

The IMP560 is designed for systems with modest EL lamp drive voltage requirements. It is ideal for low ambient light applications or where small lamps are used. With just one-half the inductor current of the IMP803, the IMP560 reduces system power consumption and extends battery life. Input supply voltage range is 2.0V to 6.5V and quiescent current is a low 420µA. Typical EL lamp drive voltage is 120V peak-to-peak.

An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 120V peak-to-peak. This conserves power and extends battery life.

A disable mode puts the chip into a low current drain mode. With a 3.0V supply, quiescent current drops to 200nA maximum, 50nA typical.

Key Features
- 120V peak-to-peak typical AC output voltage
- Low input current (w/inductor current)......12mA
- Low disabled input current......50nA
- Wide operating voltage range - from 2.0V to 6.5V
- Simple design requires few passive components
- Adjustable output lamp frequency controls lamp color and power consumption
- Adjustable converter frequency for minimum power consumption
- IMP803 pin compatible
- MicroSO package option

IMP803: High-Voltage EL Lamp Driver

The IMP803 drives EL lamps of up to 30nF capacitance to high brightness. EL lamps with capacitance greater than 30nF can be driven but will be less bright. The typical regulated output voltage that is applied to the EL lamp is 180V peak-to-peak.

The IMP803 operates over a 2.0V to 6.5V supply voltage range. A regulated, low-power source can supply the low quiescent current of the IMP803. The inductor may be driven from an independent, unregulated supply voltage in dual supply applications. An internal circuit shuts down the switching regulator when the lamp drive voltage reaches 180V peak-to-peak. This conserves power and extends battery life.

Key Features
- Low Power: 420µA typical VDD current
- Wide operating voltage range - from 2.0V to 6.5V
- 180V peak-to-peak typical AC output voltage
- Large output load capability - drive lamps with more than 30nF capacitance
- Adjustable output lamp frequency for control of lamp color, lamp life, and power consumption
- Adjustable converter frequency to minimize power consumption
- Device can be Enabled/Disabled
- Low quiescent current - 20nA (disabled)
- High-Voltage CMOS Process
- MicroSO package option

EL Lamp Driver Product Summary Table

<table>
<thead>
<tr>
<th>Part</th>
<th>Input Voltage Range (V)</th>
<th>Typical Output Voltage (Vpp)</th>
<th>Regulated Output Voltage</th>
<th>Adjustable Lamp Drive and Boost Frequency</th>
<th>Low Power Disable Mode</th>
<th>Packages</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP522</td>
<td>2.0 to 6.5</td>
<td>220 (Dual Outputs)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>10-pin, MicroSO</td>
</tr>
<tr>
<td>IMP525</td>
<td>0.9 to 2.5</td>
<td>112</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>8-pin, MicroSO &amp; SO</td>
</tr>
<tr>
<td>IMP527</td>
<td>0.9 to 2.5</td>
<td>180</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>8-pin, MicroSO &amp; SO</td>
</tr>
<tr>
<td>IMP528</td>
<td>2.0 to 6.5</td>
<td>220</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>8-pin, MicroSO &amp; SO</td>
</tr>
<tr>
<td>IMP560</td>
<td>2.0 to 6.5</td>
<td>120</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>8-pin, MicroSO &amp; SO</td>
</tr>
<tr>
<td>IMP803</td>
<td>2.0 to 6.5</td>
<td>180</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>8-pin, MicroSO &amp; SO</td>
</tr>
</tbody>
</table>

Die are also available.
**EL Lamp Driver Development Kits**

Several demonstration boards and evaluation kits are available to reduce time-to-market. The kits are available by calling IMP Customer Service at 408.432.9100.

<table>
<thead>
<tr>
<th>Item</th>
<th>Device/Package</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP803EV1</td>
<td>IMP803LG</td>
<td>Evaluation board.</td>
</tr>
<tr>
<td>IMPxxxDBM</td>
<td>Any MicroSO</td>
<td>Development board. For evaluating IC sample(s) in-circuit.</td>
</tr>
<tr>
<td>IMPxxxDBS</td>
<td>Any SO</td>
<td>Development board. For evaluating IC sample(s) in-circuit.</td>
</tr>
</tbody>
</table>

Note: “xxx” denotes any driver; 525, 527, 528, 560 or 803.

**Electroluminescent Lamp Applications and Benefits**

Liquid Crystal Displays (LCDs) must be lighted for viewing in darkness or low ambient light conditions. Typically, light is projected forward from the back of the LCD display. EL lamps are popular backlights for liquid crystal displays and keypads because EL lamps are flexible, lightweight, thin, vibration and impact resistant, and can be shaped into small, complex or irregular forms. EL lamps evenly light an area without creating “bright-spots”.

Since EL lamps typically consume much less current than incandescent bulbs or light emitting diodes (LEDs), their low power consumption, low heat generation and flexibility make them ideal for battery powered portable applications.

EL lamp backlighting applications include: keyless entry systems; audio/video equipment remote controllers; PDA keyboards and displays; timepieces and watches; LCD displays in cellular phones, pagers, and handheld Global Positioning Systems (GPS); face illumination for instrumentation; assistance lighting for buildings; and decorative lighting for sign-displays and merchandising displays.

**Typical EL Lamp Applications**

- PDAs
- Safety illumination
- Portable instrumentation
- Battery-operated displays
- LCD modules
- Toys
- Automotive displays
- Cellular phones
- Night lights
- Audio and TV remote control units
- Panel meters
- Pagers
- Clocks and radios
- Portable GPS receivers
- Handheld computers
- Caller ID

**EL Driver Product Updates**

New product information and application notes can be obtained by visiting the IMP web site at [www.impweb.com](http://www.impweb.com) or by sending email to info@impinc.com.
Dual EL Lamp Driver

The IMP522 is a dual-output, high-voltage electroluminescent (EL) lamp driver. Either or both EL lamp driver outputs can be turned ON with the LMPSEL select pin. One EL lamp is connected between \( V_A \) and \( V_{AB} \) and the other is connected between \( V_B \) and \( V_{AB} \). \( V_{AB} \) is a common pin for both lamps. With an input supply voltage between 2.0V and 6.5V, the typical regulated lamp drive voltage is 220V peak-to-peak.

The device uses a single inductor and a minimum number of passive components: a storage capacitor, a fast recovery diode and two resistors to set the PWM and EL drive frequencies. These can be independently set to optimize brightness and minimize power consumption. \( R_{SW} \) is connected between the \( R_{SW-OSC} \) pin and the supply pin \( V_{DD} \) to set the frequency for the internal 3.0\( \Omega \) switching MOSFET. The switch duty cycle is 88%. The EL lamp driver frequency is set by \( R_{EL-OSC} \) connected between the \( R_{EL-OSC} \) pin and the \( V_{DD} \) pin.

Designed to minimize battery current drain, the IMP522 draws 2mA maximum. A power-saving shutdown mode reduces current to 2µA maximum.

The IMP522 is available in a compact 10-pin MicroSO package and in die form.

Key Features

- Drive two EL lamps independently
- Digital LMPSEL pin
  - Activate either or both EL output drivers
- 220V\textsubscript{P-P} typical AC output voltage drives 30nF EL lamps
- Wide operating voltage range: 2V to 6.5V
- Low current consumption: 2mA maximum
- Disable mode extends battery life
  - Disable current 2µA maximum
- Compact 10-pin MicroSO package
- High-voltage, low-cost CMOS process

Applications

- Cellular phones
- PDAs/Handheld computers
- Toys/Consumer electronics
- Safety Illumination
- LCD modules
- Remote controls

Block Diagram

![Diagram of the IMP522 block diagram showing connections for L\textsubscript{x} (4), C\textsubscript{S} (3), V\textsubscript{A} (8), V\textsubscript{AB} (7), V\textsubscript{B} (5), and V\textsubscript{DD} connections.](image)
**Pin Configuration**

![Pin Diagram](image)

**Ordering Information**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Input Voltage</th>
<th>Temperature Range</th>
<th>Pins-Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP522EMB</td>
<td>2.0V to 6.5V</td>
<td>–40°C to +85°C</td>
<td>10-MicroSO</td>
</tr>
</tbody>
</table>

Add /T to ordering part number for Tape and Reel.

**Absolute Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD, RSW-Osc and RELOSC</td>
<td></td>
<td>–0.5V to +7.0V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Csl, LS</td>
<td></td>
<td>–0.5V to +120V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td></td>
<td>–40°C to +85°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td></td>
<td>–65°C to +150°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Dissipation (MicroSO)</td>
<td></td>
<td>500mW</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VA, VB, VAB</td>
<td></td>
<td>–0.5V to VCS (pin 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: All voltages are referenced to GND.

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.

**Electrical Characteristics**

Unless otherwise noted, VDD = 3.0V, RSW = 910kΩ, REL = 2.7MΩ, L = 220µH and TA = 25°C.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON-resistance of MOS Switch</td>
<td>RDS(ON)</td>
<td>I = 100mA</td>
<td>3.5</td>
<td>8</td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>Output Voltage Regulation</td>
<td>VCSREG</td>
<td></td>
<td>110</td>
<td>120</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Output Voltage Peak-to-Peak (in regulation)</td>
<td>VAV = VAB, VB - VAB</td>
<td>VDD = 2.0 to 6.5V</td>
<td>220</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Output Drive Frequency (either output)</td>
<td>fEL</td>
<td>See Figure 1</td>
<td>2</td>
<td>μA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switching Frequency</td>
<td>fSW</td>
<td>See Figure 1</td>
<td>61</td>
<td>kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switching Duty Cycle</td>
<td>DSW</td>
<td>See Figure 1</td>
<td>88</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Input Current:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IcD Without Inductor Current</td>
<td>IcD</td>
<td>See Figure 1</td>
<td>1.0</td>
<td>2.0</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>IcD Plus Inductor Current (1 Load)</td>
<td>IcD</td>
<td>See Figure 1</td>
<td>21</td>
<td>31</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>IcD Plus Inductor Current (2 Load)</td>
<td>IcD</td>
<td>See Figure 1</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>
Pin Descriptions

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$V_{DD}$</td>
<td>Positive voltage supply. Inductor L may be connected here or to a separate unregulated supply.</td>
</tr>
<tr>
<td>2</td>
<td>$R_{SW-OSC}$</td>
<td>Switch-mode resistor pin. The external resistor $R_{SW}$ determines switching frequency.</td>
</tr>
<tr>
<td>3</td>
<td>$C_S$</td>
<td>Boost converter storage capacitor. The voltage across the EL lamp is approximately equal to twice the voltage at $C_S$.</td>
</tr>
<tr>
<td>4</td>
<td>$L_X$</td>
<td>Connection to flyback inductor L.</td>
</tr>
<tr>
<td>5</td>
<td>$V_B$</td>
<td>Output for EL Lamp B.</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>Ground.</td>
</tr>
<tr>
<td>7</td>
<td>$V_{AB}$</td>
<td>Common terminal for both EL lamps.</td>
</tr>
<tr>
<td>8</td>
<td>$V_A$</td>
<td>Output for EL Lamp A.</td>
</tr>
<tr>
<td>9</td>
<td>LMPSEL</td>
<td>Digital three-state input pin. Select either lamp A or lamp B or both lamps.</td>
</tr>
<tr>
<td>10</td>
<td>$R_{EL-OSC}$</td>
<td>The EL lamp oscillator frequency setting pin. External resistor $R_{EL}$ connected to $V_{DD}$ sets the EL Lamp drive frequency for both lamps.</td>
</tr>
</tbody>
</table>

Application Information

ON = $V_{DD}$
OFF = 0V

$V_{DD}$ = 400V

Enable/Disable Strobe

$R_{SW}$ = 910kΩ
$L = 220\mu H$

$R_{EL}$ = 2.7MΩ

$10\mu F$

$0.1\mu F$

Figure 1. Test Circuit
Application Information

EL Lamp Drive
The outputs $V_A - V_{AB}$ and $V_B - V_{AB}$ are configured as H-bridges, driven by the EL oscillator. Each output is switched between $C_S$ and ground on alternate phases, creating peak-to-peak signals across the EL lamps of twice the regulated voltage.

EL Lamp Selection: LMPSEL
The digital input pin LMPSEL allows either or both EL lamps to be active. Lamp A is active when LMPSEL is LOW and lamp B is active when LMPSEL is HIGH. When LMPSEL is left floating or driven by a three-state driver in the high impedance state, both lamp driver outputs are active.

<table>
<thead>
<tr>
<th>LMPSEL Signal</th>
<th>Lamp A Drive $V_A$ and $V_{AB}$</th>
<th>Lamp B Drive $V_B$ and $V_{AB}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>LOW</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Floating/</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>High Impedance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The logic HIGH signal level is defined as greater than $0.7V_{DD}$ and logic LOW is defined as less than $0.3V_{DD}$. A floating level is recognized with the signal level between $0.3V_{DD}$ and $0.7V_{DD}$, or when the output impedance of the driving voltage signal source is infinite (driver in OFF state).

Both drivers are OFF if the IMP522 is disabled.

EL Driver Output Overvoltage Regulator
The IMP522 maximum $V_{CS}$ output voltage is between 110V and 120V. The internal overvoltage regulator skips the inductor switching whenever the voltage on the $C_S$ pin exceeds the regulation threshold. The internal overvoltage detection trip point has a hysteresis of 1V and a range of 110V to 120V at room temperature.

PWM Circuit Switching
The switching MOSFET is driven by the PWM signal (nominally 61kHz). During the first 88% of the period, the switch is ON, providing a low impedance path (<8Ω) from $L_X$ to ground. This causes the external inductor to charge. In the last 12% of the period, the MOSFET is turned OFF. This causes the voltage on the output of $L_X$ to rise up to a high value. At some point, this will forward-bias the external diode, thus pumping charge into the storage capacitor $C_S$. The voltage on $C_S$ increases each cycle to between 110V and 120V. When the internal regulation trip-point is reached, the overvoltage regulator turns the MOSFET switch OFF to conserve power.
Power Sequencing

To power up the chip, the $R_{SW-OSC}$ pin is connected to $V_{DD}$ through the external $R_{SW}$ resistor. The voltage on the pin will charge up to $V_{DD}/2$. An internal threshold detector circuit monitors the pin voltage and when it exceeds the threshold range (0.2V to 0.9V) it powers up the oscillator and internal bias modules. This starts a delay counter which is one half of the EL oscillator period, after which power to the high voltage internal modules is applied. The IMP522 is then operating fully.

To power down the chip, $R_{SW}$ is driven to ground via a switch or logic gate. When the voltage on the driver side of the resistor falls below $V_{DD}/2$, there will be no input bias current into the $R_{SW-OSC}$ pin. This immediately powers down the internal high-voltage circuits, which effectively shuts the lamp off. At this point the oscillator and bias modules still draw quiescent current, but oscillations have ceased. As the $R_{SW-OSC}$ pin voltage falls below 0.1, the oscillator and bias modules are also fully powered down.

Power Saving Disable Mode

The IMP522 can be powered up and down with $R_{SW-OSC}$. In normal operation, this resistor on the $R_{SW-OSC}$ pin is connected to $V_{DD}$ or another voltage source. To power down (disable) the IMP522, $R_{SW}$ is connected to ground.

When disabled, the IMP522 quiescent current drops to typically 20nA.

In die form, an extra pin ENABLE is available (contact factory). Connecting this pad to $V_{DD}$ disables the chip. The ENABLE signal can be driven by a microcontroller.

Oscillator Frequency Adjustment

The EL lamp drive and PWM boost converter oscillation frequencies can be programmed independently.

The $R_{SW}$ resistor, connected between the $R_{SW-OSC}$ pin and $V_{DD}$, determines the Inductor Switching (or PWM-) frequency. For the recommended nominal resistor value of 910k$\Omega$, the frequency is 61kHz. For other resistor values, the frequency is inversely proportional to the resistor value. Increasing the resistance will lower the frequency.

The $R_{EL}$ resistor, connected between the $R_{EL-OSC}$ pin and $V_{DD}$, determines the EL lamp drive frequency. For the recommended nominal resistor value of 2.7M$\Omega$, the frequency is 250Hz. For other resistor values, the frequency is inversely proportional to the resistor value: increasing the resistance will lower the frequency.

<table>
<thead>
<tr>
<th>Oscillator</th>
<th>Nominal Resistor</th>
<th>Nominal Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>EL Lamp Drive</td>
<td>$R_{EL} = 2.7M\Omega$</td>
<td>250Hz</td>
</tr>
<tr>
<td>Inductor Switch (PWM)</td>
<td>$R_{SW} = 910k\Omega$</td>
<td>61kHz</td>
</tr>
<tr>
<td>Notes</td>
<td></td>
<td></td>
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<tr>
<td>-------</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Project</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>
The IMP525 is an Electroluminescent (EL) lamp driver designed for systems that must operate down to 1 volt and below. The input supply voltage range is 0.9V to 2.5V. Typical output lamp drive voltage is 112V. All four EL lamp-driving functions are on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. EL lamps of up to 6nF capacitance can be driven to high brightness.

The circuit requires few external components; one inductor, one diode, one capacitor and two resistors. The resistors set the frequency for the two oscillators.

A disable mode puts the chip into a low current-drain state. When disabled, quiescent current drops to 1µA typical with a VDD of 1.5V. The chip can be disabled by connecting RSW, the oscillator frequency setting resistor, to ground. A disable pad (active low), accessible only on the die, can also be used to disable the driver.

An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 112V peak-to-peak. This conserves power and extends battery life.

The IMP525 is available in MicroSO and SO-8 packages and in die form.
**Parameter** | **Symbol** | **Conditions** | **Min** | **Typ** | **Max** | **Units**
--- | --- | --- | --- | --- | --- | ---
ON-resistance of MOS Switch | $R_{DS(on)}$ | $I = 50mA$ | 0.9 | 15 | Ω
Operating Voltage | $V_{CS}$ | $V_{DD} = 1.5V$, See Figure 1, Table 1 | 52 | 58 | 65 | V
Output Voltage at $C_S$ | $V_{CS}$ | $V_{DD} = 0.9V$, See Figure 1, Table 2 | 50 | | | V
Output Voltage Peak-to-Peak | $V_A-V_B$ | $V_{DD} = 1.5V$, See Figure 1 | 104 | 112 | 124 | V<br>Peak-to-Peak
Quiescent $V_{DD}$ Supply Current, Disabled (Disable pin available on die only) | $I_{QDIS}$ | Disable = HIGH | 70 | | | nA
Quiescent $V_{DD}$ Supply Current, Disabled | $I_{QDIS}$ | $R_{SW-OSC} = GND$ | 1.0 | 2.0 | μA
Input Current at $V_{DD}$ Pin | $I_{DD}$ | $V_{DD} = 0.9V$ to 1.5V | 23 | 32 | mA
Input Current: $I_{DD}$ Plus Inductor Current | $I_{IN}$ | $V_{DD} = 1.5V$ | 1.5 | | | mA
$V_{A-B}$ Output Drive Frequency | $f_{EL}$ | $V_{DD} = 1.5V$, See Figure 1, Table 1 | 500 | | | Hz
Boost Converter Switching Frequency | $f_{SW}$ | $V_{DD} = 1.5V$, See Figure 1, Table 1 | 26 | | | kHz
Switching Duty Cycle | $D_{SW}$ | $V_{DD} = 1.5V$, See Figure 1 | 87.5 | | | %
Disable Input LOW Voltage (Disable pin available on die only) | $V_{DISL}$ | GND | 0.2 | | | V
Disable Input HIGH Voltage (Disable pin available on die only) | $V_{DISH}$ | $V_{DD}-0.5V$ | | | | V

*Disable pad not active
**Disable pad active

Note: All voltages are referenced to GND.

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.
**Typical Characteristics**

**EL Lamp Drive Frequency**

![Graph showing EL Lamp Drive Frequency](525_08.eps)

- **VDD = 1.5V**
- **TA = 25°C**

**Boost Converter Switching Frequency**

![Graph showing Boost Converter Switching Frequency](525_10.eps)

- **VDD = 1.5V**
- **TA = 25°C**

**EL Lamp Drive Period**

![Graph showing EL Lamp Drive Period](525_07.eps)

- **VDD = 1.5V**
- **TA = 25°C**

**Boost Converter Switching Period**

![Graph showing Boost Converter Switching Period](525_09.eps)

- **VDD = 1.5V**
- **TA = 25°C**
### Pin Descriptions

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt;</td>
<td>Positive voltage supply for the IMP525. Inductor L may be connected here or to a separate supply.</td>
</tr>
<tr>
<td>2</td>
<td>R&lt;sub&gt;SW-OSC&lt;/sub&gt;</td>
<td>Switch-mode resistor pin. Switching frequency is determined by external resistor R&lt;sub&gt;SW&lt;/sub&gt;, connected between pin 2 and V&lt;sub&gt;DD&lt;/sub&gt;.</td>
</tr>
<tr>
<td>3</td>
<td>C&lt;sub&gt;S&lt;/sub&gt;</td>
<td>Boost converter storage capacitor. The voltage across the EL lamp is equal to twice the voltage at C&lt;sub&gt;S&lt;/sub&gt;.</td>
</tr>
<tr>
<td>4</td>
<td>L&lt;sub&gt;X&lt;/sub&gt;</td>
<td>Connection to flyback inductance, L.</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground pin.</td>
</tr>
<tr>
<td>6</td>
<td>V&lt;sub&gt;B&lt;/sub&gt;</td>
<td>EL lamp drive. The lamp is connected to a high-voltage bridge circuit with V&lt;sub&gt;B&lt;/sub&gt; providing the complementary connection to V&lt;sub&gt;A&lt;/sub&gt;.</td>
</tr>
<tr>
<td>7</td>
<td>V&lt;sub&gt;A&lt;/sub&gt;</td>
<td>EL lamp drive. (See above)</td>
</tr>
<tr>
<td>8</td>
<td>R&lt;sub&gt;EL-OSC&lt;/sub&gt;</td>
<td>The EL lamp oscillator frequency-setting pin. The frequency is controlled by resistor R&lt;sub&gt;EL&lt;/sub&gt;, connected from pin 8 to V&lt;sub&gt;DD&lt;/sub&gt;.</td>
</tr>
<tr>
<td></td>
<td>DIS</td>
<td>Available only in die form. Setting DIS HIGH disables the chip.</td>
</tr>
</tbody>
</table>

### External Pad

**DIS** Available only in die form. Setting DIS HIGH disables the chip.

### External Component Components

<table>
<thead>
<tr>
<th>External Component</th>
<th>Description and Selection Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode</td>
<td>A fast reverse recovery diode, with BV &gt; 100, such as a 1N4148.</td>
</tr>
<tr>
<td>Capacitor C&lt;sub&gt;S&lt;/sub&gt;</td>
<td>The high voltage capacitor that stores the inductive energy transferred through the catch diode. A 100 volt capacitor between 10nF and 100nF is recommended.</td>
</tr>
<tr>
<td>Resistor R&lt;sub&gt;EL&lt;/sub&gt;</td>
<td>The EL lamp oscillator frequency-setting resistor. R&lt;sub&gt;EL&lt;/sub&gt; is connected between pin 8 and V&lt;sub&gt;DD&lt;/sub&gt;, providing a frequency inversely proportional to R&lt;sub&gt;EL&lt;/sub&gt;; as R&lt;sub&gt;EL&lt;/sub&gt; increases, the EL lamp frequency decreases along with the current drawn by the lamp. Lamp color is also determined by this frequency. A 1MΩ resistor between the R&lt;sub&gt;EL-OSC&lt;/sub&gt; pin and the V&lt;sub&gt;DD&lt;/sub&gt; supply results in a lamp frequency around 500Hz.</td>
</tr>
<tr>
<td>Resistor R&lt;sub&gt;SW&lt;/sub&gt;</td>
<td>Switching Oscillator frequency-setting resistor. R&lt;sub&gt;SW&lt;/sub&gt; is connected between the R&lt;sub&gt;SW-OSC&lt;/sub&gt; pin and the V&lt;sub&gt;DD&lt;/sub&gt; supply. The switching frequency is inversely proportional to the resistor value, dropping as the resistance increases.</td>
</tr>
<tr>
<td>Capacitor C&lt;sub&gt;SW&lt;/sub&gt;</td>
<td>This is an optional noise-suppression capacitor connected from ground to the R&lt;sub&gt;SW-OSC&lt;/sub&gt; pin. A 100pF capacitor is recommended.</td>
</tr>
<tr>
<td>Inductor L</td>
<td>The inductor provides the voltage boost needed by means of inductive “flyback”. The internal MOSFET switch alternately opens and closes the ground connection for the inductor at the L&lt;sub&gt;X&lt;/sub&gt; pin. When the switch opens, the inductor potential will forward-bias the diode and the current will pass through to the storage capacitor C&lt;sub&gt;S&lt;/sub&gt;, charging it to a high voltage. As the value of the inductor is increased, the switching frequency set by R&lt;sub&gt;SW&lt;/sub&gt; should also be increased to prevent saturation. In general, smaller value inductors that can handle more current are more desirable when larger-area EL lamps must be driven. A small electrolytic capacitor (10µF, 16V), normally present across the inductor supply V&lt;sub&gt;IN&lt;/sub&gt;, will likely eliminate the need for C&lt;sub&gt;SW&lt;/sub&gt;.</td>
</tr>
</tbody>
</table>
**Test Circuit**

*Figure 1* shows the IMP525 configured to drive an EL lamp, represented as a 3nF capacitor.

---

**Figure 1. Test Circuit**

**Table 1. $V_{IN} = 1.5V$**

<table>
<thead>
<tr>
<th>Component</th>
<th>Connections</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{SW}$</td>
<td>$V_{DD}, R_{SW-OSC}$</td>
<td>1M$\Omega$</td>
<td>Boost converter oscillator bias resistor</td>
</tr>
<tr>
<td>$R_{EL}$</td>
<td>$V_{DD}, R_{EL-OSC}$</td>
<td>1$\Omega$</td>
<td>EL lamp driver oscillator bias resistor</td>
</tr>
<tr>
<td>$L$</td>
<td>$V_{DD}, L_{X}$</td>
<td>330$\mu$H</td>
<td>Boost converter inductor</td>
</tr>
<tr>
<td>$C_{S}$</td>
<td>$C_{S}, GND$</td>
<td>0.1$\mu$F/100V</td>
<td>Boost converter storage capacitor</td>
</tr>
<tr>
<td>$D$</td>
<td>$L_{X}, C_{S}$</td>
<td>1N4148</td>
<td>Switching diode</td>
</tr>
<tr>
<td>$C_{SW}$</td>
<td>$R_{SW-OSC}, GND$</td>
<td>0.1nF</td>
<td>Noise-suppression capacitor</td>
</tr>
</tbody>
</table>

*Notes. 1. Larger values may be required depending upon supply impedance. 2. Murata LQH4N331K04 (8.2$\Omega$ max. DCR)*

**Table 2. $V_{IN} = 0.9V$**

<table>
<thead>
<tr>
<th>Component</th>
<th>Connections</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{SW}$</td>
<td>$V_{DD}, R_{SW-OSC}$</td>
<td>1.0$\Omega$</td>
<td>Boost converter oscillator bias resistor</td>
</tr>
<tr>
<td>$R_{EL}$</td>
<td>$V_{DD}, R_{EL-OSC}$</td>
<td>2.62$\Omega$</td>
<td>EL lamp driver oscillator bias resistor</td>
</tr>
<tr>
<td>$L$</td>
<td>$V_{DD}, L_{X}$</td>
<td>680$\mu$H</td>
<td>Boost converter inductor</td>
</tr>
<tr>
<td>$C_{S}$</td>
<td>$C_{S}, GND$</td>
<td>0.1$\mu$F/100V</td>
<td>Boost converter storage capacitor</td>
</tr>
<tr>
<td>$D$</td>
<td>$L_{X}, C_{S}$</td>
<td>1N4148</td>
<td>Switching diode</td>
</tr>
<tr>
<td>$C_{SW}$</td>
<td>$R_{SW-OSC}, GND$</td>
<td>0.1nF</td>
<td>Noise-suppression capacitor</td>
</tr>
</tbody>
</table>

*Notes. 3. Coilcraft DS1608C-684 (2.2$\Omega$ max. DCR)*
Enable/Disable Operation

Figure 2 shows how the IMP525 can be enabled via a logic gate that connects \( R_{SW} \) to \( V_{DD} \), and disabled by connecting it to ground.

The IMP525 can also be disabled using a pad on the die. The Disable function pin is not available in packaged parts.

<table>
<thead>
<tr>
<th>Enable/Disable Table</th>
<th>IMP525 State</th>
<th>Disable PAD Connection (Available only with dice)</th>
<th>IMP525 State</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_{SW} ) Connection</td>
<td>( V_{DD} ) Enabled</td>
<td>( \text{HIGH (V}_{DD} ) Disabled</td>
<td>( \text{LOW (Ground) Enabled}</td>
</tr>
<tr>
<td>Ground</td>
<td>Disabled</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Note: 
1. Murata part # LQH4N331K04 (DC resistance < 8.2 \( \Omega \))
2. Larger values may be required depending upon supply impedance.
* Optional |

High Voltages Present

The IMP525 generates high voltages and caution should be exercised.

Inductor Manufacturers

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Series</th>
<th>USA Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toko</td>
<td>D52FU</td>
<td>(847) 297-0070</td>
</tr>
<tr>
<td>Coilcraft</td>
<td>DS1608, DO1608, DT1608</td>
<td>(847) 639-6400</td>
</tr>
<tr>
<td>River Electronics</td>
<td>FLC32</td>
<td>(310) 320-7488</td>
</tr>
<tr>
<td>Murata</td>
<td>LQH4N</td>
<td>(800) 831-9172</td>
</tr>
</tbody>
</table>
Single Cell Battery Powered Electroluminescent Lamp Driver/Inverter

The IMP527 is an Electroluminescent (EL) lamp driver designed for systems that must operate down to 1 volt and below. The input supply voltage range is 0.9V to 2.5V. Typical output lamp drive voltage is 180V. All four EL lamp-driving functions are on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. EL lamps of up to 6nF capacitance can be driven to high brightness.

The circuit requires few external components; one inductor, one diode, one capacitor and two resistors. The resistors set the frequency for the two oscillators.

A disable mode puts the chip into a low current-drain state. When disabled, quiescent current drops to 1µA typical with a VDD of 1.5V. The chip can be disabled by connecting RSW, the oscillator frequency setting resistor, to ground. A disable pad (active low), accessible only on the die, can also be used to disable the driver.

An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 180V peak-to-peak. This conserves power and extends battery life.

The IMP527 is available in MicroSO and SO-8 packages and in die form.
### Pin Configuration

![Pin Configuration Diagram](image)

### Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Input Voltage</th>
<th>Regulated Output Voltage</th>
<th>Temperature Range</th>
<th>Pins-Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP527EMA</td>
<td>0.9V to 2.5V</td>
<td>YES</td>
<td>−40°C to +85°C</td>
<td>8-MicroSO</td>
</tr>
<tr>
<td>IMP527ESA</td>
<td>0.9V to 2.5V</td>
<td>YES</td>
<td>−40°C to +85°C</td>
<td>8-SO</td>
</tr>
<tr>
<td>IMP527/D*</td>
<td>0.9V to 2.5V</td>
<td>YES</td>
<td>25°C</td>
<td>Dice</td>
</tr>
<tr>
<td>IMP527/D1**</td>
<td>0.9V to 2.5V</td>
<td>YES</td>
<td>25°C</td>
<td>Dice</td>
</tr>
</tbody>
</table>

* Disable pad not active
** Disable pad active

Note: All voltages are referenced to GND.

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.

### Electrical Characteristics

Unless otherwise noted, $V_{DD} = 1.5V$, $R_{SW} = 1M\Omega$, $R_{REL} = 1M\Omega$, and $T_A = 25°C$.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON-resistance of MOS Switch</td>
<td>$R_{DS(ON)}$</td>
<td>$I = 50mA$</td>
<td>15</td>
<td></td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td></td>
<td></td>
<td>0.9</td>
<td></td>
<td>2.5</td>
<td>V</td>
</tr>
<tr>
<td>Output Voltage at $C_S$</td>
<td>$V_{CS}$</td>
<td>$V_{DD} = 1.5V$, See Figure 1, Table 1</td>
<td>80</td>
<td>90</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Output Voltage at $C_S$</td>
<td>$V_{CS}$</td>
<td>$V_{DD} = 0.9V$, See Figure 1, Table 2</td>
<td>50</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Output Voltage Peak-to-Peak</td>
<td>$V_{A-V_B}$</td>
<td>$V_{DD} = 1.5V$, See Figure 1</td>
<td>180</td>
<td></td>
<td></td>
<td>V_{P-P}</td>
</tr>
<tr>
<td>Quiescent $V_{DD}$ Supply Current, Disabled</td>
<td>$I_{QDIS}$</td>
<td>Disable = HIGH</td>
<td>70</td>
<td></td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>(Disable pin available on die only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quiescent $V_{DD}$ Supply Current, Disabled</td>
<td>$I_{QDIS}$</td>
<td>$R_{SW-OSC} = GND$, $V_{DD} = 1.5V$</td>
<td>1.0</td>
<td>2.0</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>Input Current at $V_{DD}$ Pin</td>
<td>$I_{ID}$</td>
<td>$V_{DD} = 0.9V$ to $1.5V$</td>
<td>1.5</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Input Current: $I_{ID}$ Plus Inductor Current</td>
<td>$I_{IN}$</td>
<td>$V_{DD} = 1.5V$, See Figure 1, Table 1</td>
<td>26</td>
<td>32</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>$V_{A-B}$ Output Drive Frequency</td>
<td>$f_{EL}$</td>
<td>$V_{DD} = 1.5V$, See Figure 1, Table 1</td>
<td>500</td>
<td></td>
<td></td>
<td>kHz</td>
</tr>
<tr>
<td>Boost Converter Switching Frequency</td>
<td>$f_{SW}$</td>
<td>$V_{DD} = 1.5V$, See Figure 1, Table 1</td>
<td>26</td>
<td></td>
<td></td>
<td>kHz</td>
</tr>
<tr>
<td>Switching Duty Cycle</td>
<td>$D_{SW}$</td>
<td>$V_{DD} = 1.5V$, See Figure 1</td>
<td>87.5</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Disable Input LOW Voltage (Disable pin available on die only)</td>
<td>$V_{DISL}$</td>
<td>$GND$</td>
<td>0.2</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Disable Input HIGH Voltage (Disable pin available on die only)</td>
<td>$V_{DIH}$</td>
<td>$V_{DD}-0.5V$</td>
<td></td>
<td></td>
<td></td>
<td>V</td>
</tr>
</tbody>
</table>
Typical Characteristics

EL Lamp Drive Frequency

![Graph showing EL Lamp Drive Frequency]

- VDD = 1.5V
- TA = 25°C

Boost Converter
Switching Frequency

![Graph showing Boost Converter Switching Frequency]

- VDD = 1.5V
- TA = 25°C

EL Lamp Drive Period

![Graph showing EL Lamp Drive Period]

- VDD = 1.5V
- TA = 25°C

Boost Converter
Switching Period

![Graph showing Boost Converter Switching Period]

- VDD = 1.5V
- TA = 25°C
## Pin Descriptions

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VDD</td>
<td>Positive voltage supply for the IMP527. Inductor L may be connected here or to a separate supply.</td>
</tr>
<tr>
<td>2</td>
<td>RSW-OSC</td>
<td>Switch-mode resistor pin. Switching frequency is determined by external resistor RSW, connected between pin 2 and VDD.</td>
</tr>
<tr>
<td>3</td>
<td>CS</td>
<td>Boost converter storage capacitor. The voltage across the EL lamp is equal to twice the voltage at CS.</td>
</tr>
<tr>
<td>4</td>
<td>LX</td>
<td>Connection to flyback inductance, L.</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground pin.</td>
</tr>
<tr>
<td>6</td>
<td>VB</td>
<td>EL lamp drive. The lamp is connected to a high-voltage bridge circuit with VB providing the complementary connection to VA.</td>
</tr>
<tr>
<td>7</td>
<td>VA</td>
<td>EL lamp drive. (See above)</td>
</tr>
<tr>
<td>8</td>
<td>REL-OSC</td>
<td>The EL lamp oscillator frequency-setting pin. The frequency is controlled by resistor REL, connected from pin 8 to VDD.</td>
</tr>
</tbody>
</table>

Disable Pad DIS | Available only in die form. Setting DIS HIGH disables the chip. |

## External Components

<table>
<thead>
<tr>
<th>External Component</th>
<th>Description and Selection Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode</td>
<td>A fast reverse recovery diode, with BV &gt; 100, such as a 1N4148.</td>
</tr>
<tr>
<td>Capacitor CS</td>
<td>The high voltage capacitor that stores the inductive energy transferred through the catch diode. A 100 volt capacitor between 10nF and 100nF is recommended.</td>
</tr>
<tr>
<td>Resistor REL</td>
<td>The EL lamp oscillator frequency-setting resistor. REL is connected between pin 8 and VDD, providing a frequency inversely proportional to REL; as REL increases, the EL lamp frequency decreases along with the current drawn by the lamp. Lamp color is also determined by this frequency. A 1MΩ resistor between the REL-OSC pin and the VDD supply results in a lamp frequency around 500Hz.</td>
</tr>
<tr>
<td>Resistor RSW</td>
<td>Switching Oscillator frequency-setting resistor. RSW is connected between the RSW-OSC pin and the VDD supply. The switching frequency is inversely proportional to the resistor value, dropping as the resistance increases.</td>
</tr>
<tr>
<td>Capacitor CSW</td>
<td>This is an optional noise-suppression capacitor connected from ground to the RSW-OSC pin. A 100pF capacitor is recommended.</td>
</tr>
<tr>
<td>Inductor L</td>
<td>The inductor provides the voltage boost needed by means of inductive “flyback”. The internal MOSFET switch alternately opens and closes the ground connection for the inductor at the LX pin. When the switch opens, the inductor potential will forward-bias the diode and the current will pass through to the storage capacitor CS, charging it to a high voltage. As the value of the inductor is increased, the switching frequency set by RSW should also be increased to prevent saturation. In general, smaller value inductors that can handle more current are more desirable when larger-area EL lamps must be driven. A small electrolytic capacitor (10µF, 16V), normally present across the inductor supply VIN, will likely eliminate the need for CSW.</td>
</tr>
</tbody>
</table>
Test Circuit

*Figure 1* shows the IMP527 configured to drive an EL lamp, represented as a 3nF capacitor.

![Electroluminescent Lamp Driver Diagram](image)

**Table 1.** $V_{IN} = 1.5V$

<table>
<thead>
<tr>
<th>Component</th>
<th>Connections</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{SW}$</td>
<td>$V_{DD}, R_{SW-OSC}$</td>
<td>1MΩ</td>
<td>Boost converter oscillator bias resistor</td>
</tr>
<tr>
<td>$R_{EL}$</td>
<td>$V_{DD}, R_{EL-OSC}$</td>
<td>1MΩ</td>
<td>EL lamp driver oscillator bias resistor</td>
</tr>
<tr>
<td>$L$</td>
<td>$V_{DD}, L_x^2$</td>
<td>330µH</td>
<td>Boost converter inductor</td>
</tr>
<tr>
<td>$C_S$</td>
<td>$C_S, GND$</td>
<td>0.1µF/100V</td>
<td>Boost converter storage capacitor</td>
</tr>
<tr>
<td>$D$</td>
<td>$L_x, C_S$</td>
<td>1N4148</td>
<td>Switching diode</td>
</tr>
<tr>
<td>$C_{SW}$</td>
<td>$R_{SW-OSC}, GND$</td>
<td>0.1nF</td>
<td>Noise-suppression capacitor (optional)</td>
</tr>
</tbody>
</table>

Notes: 1. Larger values may be required depending upon supply impedance.  2. Murata LQH4N331K04 (8.2Ω max. DCR)

**Table 2.** $V_{IN} = 0.9V$

<table>
<thead>
<tr>
<th>Component</th>
<th>Connections</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{SW}$</td>
<td>$V_{DD}, R_{SW-OSC}$</td>
<td>1MΩ</td>
<td>Boost converter oscillator bias resistor</td>
</tr>
<tr>
<td>$R_{EL}$</td>
<td>$V_{DD}, R_{EL-OSC}$</td>
<td>2.62MΩ</td>
<td>EL lamp driver oscillator bias resistor</td>
</tr>
<tr>
<td>$L$</td>
<td>$V_{DD}, L_x^3$</td>
<td>680µH</td>
<td>Boost converter inductor</td>
</tr>
<tr>
<td>$C_S$</td>
<td>$C_S, GND$</td>
<td>0.1µF/100V</td>
<td>Boost converter storage capacitor</td>
</tr>
<tr>
<td>$D$</td>
<td>$L_x, C_S$</td>
<td>1N4148</td>
<td>Switching diode</td>
</tr>
<tr>
<td>$C_{SW}$</td>
<td>$R_{SW-OSC}, GND$</td>
<td>0.1nF</td>
<td>Noise-suppression capacitor (optional)</td>
</tr>
</tbody>
</table>

Notes: 3. Coilcraft DS1608C-684 (2.2Ω max. DCR)
Enable/Disable Operation

Figure 2 shows how the IMP527 can be enabled via a logic gate that connects RSW to VDD, and disabled by connecting it to ground. The IMP527 can also be disabled using a pad on the die. The Disable function pin is not available in packaged parts.

<table>
<thead>
<tr>
<th>RSW Connection</th>
<th>IMP527 State</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>Enabled</td>
</tr>
<tr>
<td>Ground</td>
<td>Disabled</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disable PAD Connection</th>
<th>IMP527 State</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Available only with dice)</td>
<td></td>
</tr>
<tr>
<td>HIGH (VDD)</td>
<td>Disabled</td>
</tr>
<tr>
<td>LOW (Ground)</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pad Connection</th>
<th>IMP527 State</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH (VDD)</td>
<td>Disabled</td>
</tr>
<tr>
<td>LOW (Ground)</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

Note:
1. Murata part # LQH4N331K04 (DC resistance < 8.2 Ω)
2. Larger values may be required depending upon supply impedance.

* Optional

High Voltages Present

The IMP527 generates high voltages and caution should be exercised.

Inductor Manufacturers

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Series</th>
<th>USA Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toko</td>
<td>D52FU</td>
<td>(847) 297-0070</td>
</tr>
<tr>
<td>Coilcraft</td>
<td>DS1608, DO1608, DT1608</td>
<td>(847) 639-6400</td>
</tr>
<tr>
<td>River Electronics</td>
<td>FLC32</td>
<td>(310) 320-7488</td>
</tr>
<tr>
<td>Murata</td>
<td>LQH4N</td>
<td>(800) 831-9172</td>
</tr>
</tbody>
</table>
High-Voltage EL Lamp Driver – 220 Vpp Drive

The IMP528 is an Electroluminescent (EL) lamp driver with the four EL lamp driving functions on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. The IMP528 drives EL lamps of up to 50nF capacitance to high brightness; EL lamps with capacitances greater than 50nF can be driven, but will be lower in light output. The typical regulated output voltage that is applied to the EL lamp is 220V peak-to-peak. The circuit requires few external components; a single inductor, single diode, two capacitors and two resistors. Two of these resistors set the frequency for two internal oscillators.

Unlike other EL lamp drivers, the IMP528 does not require an external protection resistor in series with the EL lamp.

The IMP528 operates over a 2.0V to 6.5V supply voltage range. A regulated, low-power source can supply the low quiescent current of the IMP528. The inductor may be driven from an independent, unregulated supply voltage in dual supply applications.

An internal circuit shuts down the switching regulator when the lamp drive voltage reaches 220V peak-to-peak. This conserves power and extends battery life.

The IMP528 is available in MicroSO and SO-8 packages and in die or wafer form.

**Key Features**

- 220V peak-to-peak typical AC output voltage
- Low Power: 420µA typical VDD current
- Wide operating voltage range – from 2.0V to 6.5V
- Large output load capability - drives lamps with more than 50nF capacitance
- Eliminates external protection resistor in series with EL lamp
- Adjustable output lamp frequency for control of lamp color, lamp life, and power consumption
- Adjustable converter frequency to minimize power consumption
- High-Voltage CMOS Process
- MicroSO package option

**Applications**

- GPS units/Pagers/Cellular phones
- PDAs/Handheld computers
- Safety illumination
- Portable instrumentation
- Battery-operated displays
- LCD modules
- Toys

**Block Diagram**
Pin Configuration

SO/ MicroSO

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Input Voltage</th>
<th>Regulated Output Voltage</th>
<th>Temperature Range</th>
<th>Pins-Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP528ESA</td>
<td>2.0V to 6.5V</td>
<td>Yes</td>
<td>–40°C to +85°C</td>
<td>8-SO</td>
</tr>
<tr>
<td>IMP528EMA</td>
<td>2.0V to 6.5V</td>
<td>Yes</td>
<td>–40°C to +85°C</td>
<td>8-MicroSO</td>
</tr>
<tr>
<td>IMP528/D*</td>
<td>2.0V to 6.5V</td>
<td>Yes</td>
<td>25°C</td>
<td>Dice</td>
</tr>
<tr>
<td>IMP528/D1**</td>
<td>2.0V to 6.5V</td>
<td>Yes</td>
<td>25°C</td>
<td>Dice</td>
</tr>
</tbody>
</table>

* Disable pad not active
** Disable pad active

Add /T to ordering part number for Tape and Reel.

Absolute Maximum Ratings

- \( V_{DD} \): –0.5V to +7.0V
- \( V_{RSW-OSC} \) and \( V_{REL-OSC} \): –0.5V to \( V_{DD} +0.3V \)
- \( V_{CS} \), \( V_{LX} \): –0.5V to +120V
- Operating Temperature Range: –40°C to +85°C
- Storage Temperature Range: –65°C to +150°C
- Power Dissipation (SO): 400mW
- Power Dissipation (MicroSO): 300mW
- \( V_A \), \( V_B \): –0.5V to \( V_{CS} \) (pin 3)

Electrical Characteristics

Unless otherwise noted, \( V_{DD} = 3.0V \), \( R_{SW} = 910k\Omega \), \( R_{EL} = 2.7M\Omega \), and \( T_A = 25°C \).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON-resistance of MOS Switch</td>
<td>( R_{DS(ON)} )</td>
<td>( I = 100mA )</td>
<td>3.0</td>
<td>8</td>
<td>2</td>
<td>( \Omega )</td>
</tr>
<tr>
<td>Output Voltage Regulation</td>
<td>( V_{CS} )</td>
<td>( V_{DD} = 2.0 ) to 6.5V</td>
<td>110</td>
<td></td>
<td></td>
<td>( V )</td>
</tr>
<tr>
<td>Output Voltage Peak-to-peak (in regulation)</td>
<td>( V_A - V_B )</td>
<td>( V_{DD} = 2.0 ) to 6.5V</td>
<td>220</td>
<td></td>
<td></td>
<td>( V )</td>
</tr>
<tr>
<td>Input Current at ( V_{DD} ) Pin</td>
<td>( I_{DD} )</td>
<td>( V_{DD} = 3.0V ), See Figure 1</td>
<td>420</td>
<td>700</td>
<td></td>
<td>( \mu A )</td>
</tr>
<tr>
<td>Input Current at ( V_{DD} ) Pin</td>
<td>( I_{DD} )</td>
<td>( V_{DD} = 6.0V )</td>
<td>500</td>
<td>750</td>
<td></td>
<td>( \mu A )</td>
</tr>
<tr>
<td>Quiescent ( V_{DD} ) Supply Current, Disabled</td>
<td>( I_{DDQ} )</td>
<td>( V_{RSW-OSC} &lt;100mV )</td>
<td>20</td>
<td>200</td>
<td></td>
<td>( nA )</td>
</tr>
<tr>
<td>Input Current: ( I_{DD} ) Plus Inductor Current</td>
<td>( I_{IN} )</td>
<td>( V_{DD} = 3.0V ), See Figure 1</td>
<td>21</td>
<td>31</td>
<td></td>
<td>( mA )</td>
</tr>
<tr>
<td>( V_A ), ( V_B ) Output Drive Frequency</td>
<td>( f_{EL} )</td>
<td>( V_{DD} = 3.0V ), See Figure 1</td>
<td>250</td>
<td></td>
<td></td>
<td>( Hz )</td>
</tr>
<tr>
<td>Switching Frequency</td>
<td>( f_{SW} )</td>
<td>( V_{DD} = 3.0V ), See Figure 1</td>
<td>61</td>
<td></td>
<td></td>
<td>( kHz )</td>
</tr>
<tr>
<td>Switching Duty Cycle</td>
<td>( D_{SW} )</td>
<td>( V_{DD} = 3.0V ), See Figure 1</td>
<td>88</td>
<td></td>
<td></td>
<td>( % )</td>
</tr>
</tbody>
</table>
**Pin Descriptions**

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VDD</td>
<td>Positive voltage supply for the IMP528. Inductor L may be connected here or to a separate unregulated supply.</td>
</tr>
<tr>
<td>2</td>
<td>RSW-OSC</td>
<td>Switch-mode resistor pin. Switching frequency is determined by an external resistor, RSW.</td>
</tr>
<tr>
<td>3</td>
<td>Cs</td>
<td>Boost converter storage capacitor. The voltage across the EL lamp is equal to twice the voltage at Cs.</td>
</tr>
<tr>
<td>4</td>
<td>LX</td>
<td>Connection to flyback inductance, L.</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground pin.</td>
</tr>
<tr>
<td>6</td>
<td>VB</td>
<td>EL lamp drive. The lamp is connected in a high-voltage bridge circuit with VB providing the complementary connection to VA. The peak-to-peak AC voltage across the EL lamp is thus two times VCS.</td>
</tr>
<tr>
<td>7</td>
<td>VA</td>
<td>EL lamp drive. (See above)</td>
</tr>
<tr>
<td>8</td>
<td>REL-OSC</td>
<td>The EL lamp oscillator frequency setting pin. The oscillator frequency is controlled by external resistor REL.</td>
</tr>
</tbody>
</table>

**External Components**

<table>
<thead>
<tr>
<th>External Component</th>
<th>Description and Selection Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode</td>
<td>Catch diode. A fast reverse recovery diode, with BV &gt; 150V, such as an FDLL400 (150V).</td>
</tr>
<tr>
<td>Capacitor Cs</td>
<td>This is the high voltage capacitor that stores the inductive energy transferred through the catch diode. A capacitor with WV &gt; 120V between 10nF and 100nF is recommended.</td>
</tr>
<tr>
<td>Resistor REL</td>
<td>The EL lamp oscillator frequency setting resistor. This resistor, connected between the REL-OSC pin and VDD, provides an oscillator frequency inversely proportional to REL; as REL increases, the EL lamp frequency decreases along with the current drawn by the lamp. Lamp color is also determined by this frequency. A 2.7MΩ resistor between the REL-OSC pin and the VDD supply results in a lamp frequency around 250Hz.</td>
</tr>
<tr>
<td>Resistor RSW</td>
<td>Switching Oscillator frequency setting resistor. The switching oscillator resistor is connected between the RSW-OSC pin and the VDD supply. The switching frequency is inversely proportional to the resistor value, dropping as the resistance increases.</td>
</tr>
<tr>
<td>Inductor L</td>
<td>The inductor provides the voltage boost needed by means of inductive “flyback”. The internal MOSFET switch alternately opens and closes the ground connection for the inductor at the LX pin. When this internal switch opens, the inductor potential will forward-bias the catch diode and the current will pass through the storage capacitor Cs, charging it to a high voltage. Smaller inductors are preferred to prevent saturation. As the value of the inductor increases (and the series DC resistance of the inductor decreases), the switching frequency set by RSW should be increased to prevent saturation. In general, smaller value inductors that can handle more current are more desirable when larger area EL lamps must be driven.</td>
</tr>
</tbody>
</table>
Test and Application Circuit, 3.0V

*Figure 1* shows the IMP528 configured to drive an EL lamp with a 3.0V input.

![Test and Application Circuit, 3.0V](image)

**Note:**
1. Murata part # LQH4N221K04 (DC resistance <5Ω)
2. Larger values may be required depending upon supply impedance.
3. EN is connected to VDD to enable and to GND to disable.

**Figure 1. 3.0V Application**

Dual Supply Operation with 1.5V Battery

The IMP528 can also be operate from a single battery cell when a regulated voltage higher than 2.0V is also available. This dual supply configuration, shown in *Figure 2*, uses the regulated voltage to operate the IMP528 while the energy for the high-voltage boost circuit comes from the battery.

![Dual Supply Operation with 1.5V Battery](image)

1. Larger values may be required depending upon supply impedance.
2. EN is connected to VDD to enable and to GND to disable.

**Figure 2. Dual Supply Operation**
High-Voltages Present

Switch Resistance
The IMP528 inductor switch resistance is typically below 3.5Ω, as shown in Figure 3.

The IMP528 generates high voltages and caution should be exercised.

Figure 3. Boost Switch ON-Resistance
Power Efficient
EL Lamp Driver

The IMP560 is an Electroluminescent (EL) lamp driver designed for systems with low EL lamp drive voltage requirements. It is ideal for low ambient light applications or where small lamps are used. With just one-half the inductor current of the IMP803, the IMP560 reduces system power consumption and extends battery life. Input supply voltage range is 2.0V to 6.5V and quiescent current is a low 420μA. Typical EL lamp drive voltage is ±56V.

All four EL lamp-driving functions are on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. EL lamps of up to 6nF capacitance can be driven to high brightness.

The circuit requires few external components; a single inductor, a single diode, two capacitors and three resistors. Two of these resistors set the frequencies for two internal oscillators. An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 120V peak-to-peak. This conserves power and extends battery life.

A disable mode puts the chip into a low current drain mode. With a 3.0V supply, quiescent current drops to 200nA maximum, 50nA typical. The chip is disabled by connecting the oscillator frequency setting resistor RSW to ground.

The IMP560 is available in MicroSO and SO-8 packages and in die or wafer form.

Block Diagram

Key Features
- 112V peak-to-peak typical AC output voltage
- Low input current (w/inductor current)......12mA
- Low disabled input current......50nA
- Wide operating voltage range - from 2.0V to 6.5V
- Simple design requires few passive components
- Adjustable output lamp frequency controls lamp color and power consumption
- Adjustable converter frequency for minimum power consumption
- IMP803 pin-compatible
- MicroSO package option

Applications
- Night lights
- Automotive displays
- Cellular phones
- Pagers
- Clocks and radios
- Portable GPS receivers
- LCD module backlights
**Pin Configuration**

```
<table>
<thead>
<tr>
<th>SO/MicroSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_DD</td>
</tr>
<tr>
<td>R_SW-OSC</td>
</tr>
<tr>
<td>C_S</td>
</tr>
<tr>
<td>L_X</td>
</tr>
</tbody>
</table>
```

Pin Compatible With IMP803

**Ordering Information**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Input Voltage</th>
<th>Regulated Output Voltage</th>
<th>Temperature Range</th>
<th>Pins-Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP560EMA</td>
<td>2.0V to 6.5V</td>
<td>YES</td>
<td>–40°C to +85°C</td>
<td>8-MicroSO</td>
</tr>
<tr>
<td>IMP560ESA</td>
<td>2.0V to 6.5V</td>
<td>YES</td>
<td>–40°C to +85°C</td>
<td>8-SO</td>
</tr>
<tr>
<td>IMP560/D*</td>
<td>2.0V to 6.5V</td>
<td>YES</td>
<td>25°C</td>
<td>Dice</td>
</tr>
<tr>
<td>IMP560/D1**</td>
<td>2.0V to 6.5V</td>
<td>YES</td>
<td>25°C</td>
<td>Dice</td>
</tr>
</tbody>
</table>

* Disable pad not active  
** Disable pad active

**Absolute Maximum Ratings**

Supply Voltage, \( V_{DD}, V_{SW-OSC} \) and \( V_{REL-OSC} \) … \(-0.5V \) to +7.0V  
Output Voltage, \( V_{CS} \) … \(-0.5V \) to +120V  
Operating Temperature Range … \(-40°C \) to +85°C  
Storage Temperature Range … \(-65°C \) to +150°C  
Power Dissipation (SO) … 400mW  
Power Dissipation (MicroSO) … 300mW

**Note:** All voltages are referenced to GND.  
These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.

**Electrical Characteristics**

Unless otherwise noted, \( V_{DD} = 3.0V, R_{SW} = 750k\Omega, R_{EL} = 2.0M\Omega, \) and \( T_A = 25°C. \)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON-resistance of MOS Switch</td>
<td>( R_{DS(ON)} )</td>
<td>( I = 100mA )</td>
<td>3.5</td>
<td>8</td>
<td>( \Omega )</td>
<td></td>
</tr>
<tr>
<td>Output Voltage Regulation</td>
<td>( V_{CS} )</td>
<td>( V_{DD} = 2.0 ) to 6.5V</td>
<td>52</td>
<td>56</td>
<td>65</td>
<td>V</td>
</tr>
<tr>
<td>Output Voltage Peak-to-peak (in regulation)</td>
<td>( V_A-V_B )</td>
<td>( V_{DD} = 2.0 ) to 6.5V</td>
<td>104</td>
<td>112</td>
<td>120</td>
<td>V</td>
</tr>
<tr>
<td>Quiescent ( V_{DD} ) Supply Current, Disabled</td>
<td>( I_{DDIS} )</td>
<td>( V_{RSW-OSC} &lt; 100mV )</td>
<td>50</td>
<td>200</td>
<td>nA</td>
<td></td>
</tr>
<tr>
<td>Input Current at ( V_{DD} ) Pin</td>
<td>( I_{DD} )</td>
<td>( V_{DD} = 3.0V, ) See Figure 1</td>
<td>470</td>
<td>700</td>
<td>( \mu A )</td>
<td></td>
</tr>
<tr>
<td>Input Current at ( V_{DD} ) Pin</td>
<td>( I_{DD} )</td>
<td>( V_{DD} = 5.0V, ) See Figure 2</td>
<td>500</td>
<td>750</td>
<td>( \mu A )</td>
<td></td>
</tr>
<tr>
<td>Input Current: ( I_{DD} ) Plus Inductor Current</td>
<td>( I_{IN} )</td>
<td>( V_{DD} = 3.0V, ) See Figure 1</td>
<td>12</td>
<td></td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>( V_A-V_B ) Output Drive Frequency</td>
<td>( f_{EL} )</td>
<td>( V_{DD} = 3.0V, ) See Figure 1</td>
<td>300</td>
<td>370</td>
<td>430</td>
<td>Hz</td>
</tr>
<tr>
<td>Switching Frequency</td>
<td>( f_{SW} )</td>
<td>( V_{DD} = 3.0V, ) See Figure 1</td>
<td>50</td>
<td>70</td>
<td>90</td>
<td>kHz</td>
</tr>
<tr>
<td>Switching Duty Cycle</td>
<td>( D_{SW} )</td>
<td>( V_{DD} = 3.0V, ) See Figure 1</td>
<td>88</td>
<td></td>
<td>%</td>
<td></td>
</tr>
</tbody>
</table>
**Pin Descriptions**

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VDD</td>
<td>Positive voltage supply for the IMP560. Inductor L may be connected here or to a separate unregulated supply.</td>
</tr>
<tr>
<td>2</td>
<td>RSW-OSC</td>
<td>Switch-mode resistor pin. Switching frequency is determined by an external resistor, RSW.</td>
</tr>
<tr>
<td>3</td>
<td>CS</td>
<td>Boost converter storage capacitor. The voltage across the EL lamp is equal to twice the voltage at CS.</td>
</tr>
<tr>
<td>4</td>
<td>LX</td>
<td>Connection to flyback inductance, L.</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground pin.</td>
</tr>
<tr>
<td>6</td>
<td>VB</td>
<td>EL lamp drive. The lamp is connected in a high-voltage bridge circuit with VB providing the complementary connection to VA. The peak-to-peak AC voltage across the EL lamp is thus two times VCS.</td>
</tr>
<tr>
<td>7</td>
<td>VA</td>
<td>EL lamp drive. (See above)</td>
</tr>
<tr>
<td>8</td>
<td>REL-OSC</td>
<td>The EL lamp oscillator frequency setting pin. The oscillator frequency is controlled by external resistor REL.</td>
</tr>
</tbody>
</table>

**External Components**

<table>
<thead>
<tr>
<th>External Component</th>
<th>Description and Selection Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode</td>
<td>A fast reverse recovery diode, with BV &gt; 100, such as a 1N4148.</td>
</tr>
<tr>
<td>Capacitor CS</td>
<td>This is the high voltage capacitor that stores the inductive energy transferred through the diode. A 100 volt capacitor between 10nF and 100nF is recommended.</td>
</tr>
<tr>
<td>Resistor REL</td>
<td>The EL lamp oscillator frequency setting resistor. This resistor, connected between the REL-OSC pin and ground, provides an oscillator frequency inversely proportional to REL; as REL increases, the EL lamp frequency decreases along with the current drawn by the lamp. Lamp color is also determined by this frequency. A 2MΩ resistor between the REL-OSC pin and the VDD supply results in a lamp frequency around 350Hz: a 1MΩ resistor will give ≈700Hz.</td>
</tr>
<tr>
<td>Resistor RSW</td>
<td>Switching Oscillator frequency setting resistor. The switching oscillator resistor is connected between the RSW-OSC pin and the VDD supply. The switching frequency is inversely proportional to the resistor value, dropping as the resistance increases.</td>
</tr>
<tr>
<td>Inductor L</td>
<td>The inductor provides the voltage boost needed by means of inductive “flyback”. The internal MOSFET switch alternately opens and closes the ground connection for the inductor at the LX pin. When this internal switch opens, the inductor potential will forward-bias the diode and the current will pass through the storage capacitor CS, charging it to a high voltage. Smaller inductors are preferred to prevent saturation. As the value of the inductor increases (and the series DC resistance of the inductor decreases), the switching frequency set by RSW should be increased to prevent saturation. In general, smaller value inductors that can handle more current are more desirable when larger area EL lamps must be driven.</td>
</tr>
</tbody>
</table>

**High-Voltages Present**

The IMP560 generates high voltages and caution should be exercised.
Test and Application Circuit, 3.0V

*Figure 1* shows the IMP560 configured to drive a 3-square-inch EL lamp, represented as a 10nF capacitor.

![Figure 1. 3.0V Application](image1)

Note:
1. Murata part # LQH4N561K04 (DC resistance <14.5Ω)
2. Larger values may be required depending upon supply impedance.

Test and Application Circuit, 5.0V

*Figure 2* shows a 5.0V input application driving a 6-square-inch EL lamp.

![Figure 2. 5.0V Application](image2)

Note:
1. Murata part # LQH4N561K04 (DC resistance <14.5Ω)
2. Larger values may be required depending upon supply impedance.
Enable/Disable Operation

Figure 3 shows the IMP560 can be enabled via a logic gate that connects \( R_{SW} \) to \( V_{DD} \), and disabled by connecting it to ground. \( R_{EL} \) may be connected either to \( V_{DD} \) or to the gate.

<table>
<thead>
<tr>
<th>( R_{SW} ) Connection</th>
<th>IMP560 State</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{DD} )</td>
<td>Enabled</td>
</tr>
<tr>
<td>Ground</td>
<td>Disabled</td>
</tr>
</tbody>
</table>

Figure 3. Enable/Disable Operation

Dual Supply Operation with 1.5V Battery

The IMP560 can also be operate from a single battery cell when a regulated voltage higher than 2.0V is also available. The dual supply configuration, shown in Figure 4, uses the regulated voltage to operate the IMP560 while the energy for the high-voltage boost circuit comes from the battery. The current to run the internal logic is typically 420\( \mu \)A.

The circuit of Figure 4 can also be used with batteries that exceed 6.0V as long as \( V_{DD} \) does not exceed 6.5V.

Figure 4. Dual Supply Operation with High Battery Voltages
High-Voltage EL Lamp Driver

The IMP803 is an Electroluminescent (EL) lamp driver with the four EL lamp driving functions on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. The IMP803 drives EL lamps of up to 30nF capacitance to high brightness; EL lamps with capacitances greater than 30nF can be driven, but will be lower in light output. The typical regulated output voltage that is applied to the EL lamp is 180V peak-to-peak. The circuit requires few external components, a single inductor, single diode, two capacitors and three resistors. Two of these resistors set the frequency for two internal oscillators.

The IMP803 operates over a 2.0V to 6.5V supply voltage range. A regulated, low-power source can supply the low quiescent current of the IMP803. The inductor may be driven from an independent, unregulated supply voltage in dual supply applications.

An internal circuit shuts down the switching regulator when the lamp drive voltage reaches 180V peak-to-peak. This conserves power and extends battery life.

The IMP803 is available in MicroSO and SO-8 packages and in die or wafer form.

Key Features

- Low Power: 420µA typical VDD current
- Wide operating voltage range - from 2.0V to 6.5V
- 180V peak-to-peak typical AC output voltage
- Large output load capability - drive lamps with more than 30nF capacitance
- Adjustable output lamp frequency for control of lamp color, lamp life, and power consumption
- Adjustable converter frequency to minimize power consumption
- Device can be Enabled/Disabled
- Low quiescent current – 20nA (disabled)
- High-Voltage CMOS Process
- MicroSO package option

Applications

- GPS units/Pagers/Cellular phones
- PDAs/Handheld computers
- Safety illumination
- Portable instrumentation
- Battery-operated displays
- LCD modules
- Toys
**Pin Configuration**

SO/ MicroSO

VDD 1
RSW-OSC 2
CS 3
LX 4
IMP803 5
REL-OSC 6
VA 7
VB 8
GND 9

Pin Compatible With HV803 and IMP560

**Ordering Information**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Input Voltage</th>
<th>Regulated Output Voltage</th>
<th>Temperature Range</th>
<th>Pins-Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP803LG</td>
<td>2.0V to 6.5V</td>
<td>Yes</td>
<td>–40°C to +85°C</td>
<td>8-SO</td>
</tr>
<tr>
<td>IMP803IMA</td>
<td>2.0V to 6.5V</td>
<td>Yes</td>
<td>–40°C to +85°C</td>
<td>8-MicroSO</td>
</tr>
<tr>
<td>IMP803SX*</td>
<td>2.0V to 6.5V</td>
<td>Yes</td>
<td>25°C</td>
<td>Dice</td>
</tr>
<tr>
<td>IMP803/D1**</td>
<td>2.0V to 6.5V</td>
<td>Yes</td>
<td>25°C</td>
<td>Dice</td>
</tr>
</tbody>
</table>

* Disable pad not active
** Disable pad active
Add /T to ordering part number for Tape and Reel.

**Absolute Maximum Ratings**

VDD, VRSW-OSC and VREL-OSC .................... –0.5V to +7.0V
VCS, LX ........................................ –0.5V to +120V
Operating Temperature Range ................. –40°C to +85°C
Storage Temperature Range ................... –65°C to +150°C
Power Dissipation (SO) ....................... 400mW
Power Dissipation (MicroSO) .................. 300mW
VA, VB ............................................ –0.5V to VCS (pin 3)

Note: All voltages are referenced to GND.

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.

**Electrical Characteristics**

Unless otherwise noted, VDD = 3.0V, RSW = 750kΩ, REL = 2.0MΩ, and TA = 25°C.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON-resistance of MOS Switch</td>
<td>R_DS(ON)</td>
<td>I = 100mA</td>
<td>3.5</td>
<td>8</td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>Output Voltage Regulation</td>
<td>V_CS</td>
<td>VDD = 2.0 to 6.5V</td>
<td>80</td>
<td>90</td>
<td>100</td>
<td>V</td>
</tr>
<tr>
<td>Output Voltage Peak-to-peak (in regulation)</td>
<td>VA-VB</td>
<td>VDD = 2.0 to 6.5V</td>
<td>160</td>
<td>180</td>
<td>200</td>
<td>V</td>
</tr>
<tr>
<td>Quiescent VDD Supply Current, Disabled</td>
<td>I_DDO</td>
<td>VRSW-OSC &lt;100mV</td>
<td>20</td>
<td>200</td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>Input Current at VDD Pin</td>
<td>I_DD</td>
<td>VDD = 3.0V, See Figure 1</td>
<td>420</td>
<td>700</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>Input Current at VDD Pin</td>
<td>I_DD</td>
<td>VDD = 5.0V, See Figure 2</td>
<td>500</td>
<td>750</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>Input Current: I_DD Plus Inductor Current</td>
<td>I_IN</td>
<td>VDD = 3.0V, See Figure 1</td>
<td>20</td>
<td>31</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Output Voltage at VCS</td>
<td>V_CS</td>
<td>VDD = 3.0V, See Figure 1</td>
<td>60</td>
<td>74</td>
<td>100</td>
<td>V</td>
</tr>
<tr>
<td>VA-VB Output Drive Frequency</td>
<td>f_EL</td>
<td>VDD = 3.0V, See Figure 1</td>
<td>300</td>
<td>370</td>
<td>430</td>
<td>Hz</td>
</tr>
<tr>
<td>Switching Frequency</td>
<td>f_SW</td>
<td>VDD = 3.0V, See Figure 1</td>
<td>30</td>
<td>70</td>
<td>90</td>
<td>kHz</td>
</tr>
<tr>
<td>Switching Duty Cycle</td>
<td>D_SW</td>
<td>VDD = 3.0V, See Figure 1</td>
<td>88</td>
<td></td>
<td></td>
<td>%</td>
</tr>
</tbody>
</table>
Typical Characteristics

- $V_{CS}, I_{IN}$ vs. Inductor Value
- $I_{DD}$ vs. $V_{DD}$
- $V_{CS}, I_{IN}$ vs. $V_{IN}$
- $V_{CS}, I_{IN}$ vs. $V_{IN}$
- $V_{CS}, I_{IN}$ vs. $V_{IN}$
**Pin Descriptions**

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VDD</td>
<td>Positive voltage supply for the IMP803. Inductor L may be connected here or to a separate unregulated supply.</td>
</tr>
<tr>
<td>2</td>
<td>RSW-OSC</td>
<td>Switch-mode resistor pin. Switching frequency is determined by an external resistor, RSW.</td>
</tr>
<tr>
<td>3</td>
<td>CS</td>
<td>Boost converter storage capacitor. The voltage across the EL lamp is equal to twice the voltage at CS.</td>
</tr>
<tr>
<td>4</td>
<td>LX</td>
<td>Connection to flyback inductance, L.</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground pin.</td>
</tr>
<tr>
<td>6</td>
<td>Vb</td>
<td>EL lamp drive. The lamp is connected in a high-voltage bridge circuit with Vb providing the complementary connection to Va. The peak-to-peak AC voltage across the EL lamp is thus two times VCS.</td>
</tr>
<tr>
<td>7</td>
<td>Va</td>
<td>EL lamp drive. (See above)</td>
</tr>
<tr>
<td>8</td>
<td>REL-OSC</td>
<td>The EL lamp oscillator frequency setting pin. The oscillator frequency is controlled by external resistor REL.</td>
</tr>
</tbody>
</table>

**External Components**

<table>
<thead>
<tr>
<th>External Component</th>
<th>Description and Selection Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode</td>
<td>Catch diode. A fast reverse recovery diode, with BV &gt; 100, such as a 1N4148.</td>
</tr>
<tr>
<td>Capacitor CS</td>
<td>This is the high voltage capacitor that stores the inductive energy transferred through the catch diode. A 100 volt capacitor between 10nF and 100nF is recommended.</td>
</tr>
<tr>
<td>Resistor REL</td>
<td>The EL lamp oscillator frequency setting resistor. This resistor, connected between the REL-OSC pin and VDD, provides an oscillator frequency inversely proportional to REL; as REL increases, the EL lamp frequency decreases along with the current drawn by the lamp. Lamp color is also determined by this frequency. A 2MΩ resistor between the REL-OSC pin and the VDD supply results in a lamp frequency around 350Hz: a 1MΩ resistor will give ≈700Hz.</td>
</tr>
<tr>
<td>Resistor RSW</td>
<td>Switching Oscillator frequency setting resistor. The switching oscillator resistor is connected between the RSW-OSC pin and the VDD supply. The switching frequency is inversely proportional to the resistor value, dropping as the resistance increases.</td>
</tr>
<tr>
<td>Inductor L</td>
<td>The inductor provides the voltage boost needed by means of inductive “flyback”. The internal MOSFET switch alternately opens and closes the ground connection for the inductor at the LX pin. When this internal switch opens, the inductor potential will forward-bias the catch diode and the current will pass through the storage capacitor CS, charging it to a high voltage. Smaller inductors are preferred to prevent saturation. As the value of the inductor increases (and the series DC resistance of the inductor decreases), the switching frequency set by RSW should be increased to prevent saturation. In general, smaller value inductors that can handle more current are more desirable when larger area EL lamps must be driven.</td>
</tr>
<tr>
<td>Lamp, RCL</td>
<td>An external resistor (RCL) in series with the lamp will protect the output drivers from high transient currents during lamp commutation.</td>
</tr>
</tbody>
</table>

**High Voltages Present**

The IMP803 generates high voltages and caution should be exercised.
**Test and Application Circuit, 3.0V**

*Figure 1* shows the IMP803 configured to drive a 3-square-inch EL lamp, represented as a 10nF capacitor. With a 3.0V input, the EL lamp will be driven to moderate brightness.

![Diagram 1](803_09.eps)

**Note:**
1. Murata part # LQH4N561K04 (DC resistance <14.5 Ω)
2. Larger values may be required depending upon supply impedance.

*Figure 1. 3.0V Application*

**Test and Application Circuit, 5.0V**

*Figure 2* shows a 5.0V input application driving a 6-square-inch EL lamp.

![Diagram 2](803_10.eps)

**Note:**
1. Murata part # LQH4N561K04 (DC resistance <14.5 Ω)
2. Larger values may be required depending upon supply impedance.

*Figure 2. 5.0V Application*
Test and Application Circuit, 6.0V

At higher input voltage levels, the IMP803 will drive large EL lamps. Figure 3 shows a 6.0V circuit configuration that will drive a 10 square-inch lamp.

Enable/Disable Table

<table>
<thead>
<tr>
<th>RSW Connection</th>
<th>IMP803 State</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>Enabled</td>
</tr>
<tr>
<td>GND</td>
<td>Disabled</td>
</tr>
</tbody>
</table>

Enable/Disable Operation

Figure 4 shows that the IMP803 can be enabled via a logic gate that connects \( R_{SW} \) to \( V_{DD} \) and disabled by connecting it to ground.

Note:
1. Murata part # LQH4N561K04 (DC resistance < 14.5 \( \Omega \))
2. Larger values may be required depending upon supply impedance.

Figure 4. Enable/Disable Operation
Dual Supply Operation with 1.5V Battery

The IMP803 can also operate from a single battery cell when a regulated voltage higher than 2.0V is also available. This dual supply configuration, shown in Figure 5, uses the regulated voltage to operate the IMP803 while the energy for the high-voltage boost circuit comes from the battery.

The circuit of Figure 5 thus allows operation with batteries that are below the 2V minimum specification or above the 6.0V maximum operating voltage.

---

Switch Resistance

The IMP803 inductor switch resistance is typically below 3.5Ω, as shown in Figure 6.

---

![Figure 5. Dual Supply Operation](image1)

![Figure 6. Boost Switch On Resistance](image2)
IMP525
Single Cell Battery Powered EL Lamp Driver

**General Information**

- Die Thickness: 25 mils (625 microns)
- Bond Wire Size: 1.0 mil (25 microns)
- Back Side Metal: None
- Back Side Potential: Ground
- Die Attach Method: Conductive Adhesive
- Bond Pad Metal: Aluminum, 1% Silicon, 1/2% Copper
- Bond Pad Size: 100 microns per side
- Die Size: 1.35mm x 1.54mm

**Pad Description**

<table>
<thead>
<tr>
<th>Pad Number</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VDD</td>
<td>Positive voltage supply.</td>
</tr>
<tr>
<td>2</td>
<td>RSW-OSC</td>
<td>Switch-mode oscillator frequency setting pad.</td>
</tr>
<tr>
<td>3</td>
<td>C_S</td>
<td>Boost converter storage capacitor pad.</td>
</tr>
<tr>
<td>4</td>
<td>L_x</td>
<td>Inductor pad.</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground pad.</td>
</tr>
<tr>
<td>6</td>
<td>V_B</td>
<td>EL lamp drive.</td>
</tr>
<tr>
<td>7</td>
<td>V_A</td>
<td>EL lamp drive.</td>
</tr>
<tr>
<td>8</td>
<td>R_EL-OSC</td>
<td>EL lamp oscillator frequency setting pad.</td>
</tr>
<tr>
<td>9*</td>
<td>DIS</td>
<td>Disable pad. DIS = HIGH disables chip.</td>
</tr>
</tbody>
</table>

* See Ordering Information table

**Pad Location**

<table>
<thead>
<tr>
<th>Pad Number</th>
<th>X (microns)</th>
<th>Y (microns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1153</td>
<td>1092</td>
</tr>
<tr>
<td>2</td>
<td>476</td>
<td>1226</td>
</tr>
<tr>
<td>3</td>
<td>314</td>
<td>1226</td>
</tr>
<tr>
<td>4</td>
<td>143</td>
<td>1216</td>
</tr>
<tr>
<td>5</td>
<td>111</td>
<td>460</td>
</tr>
<tr>
<td>6</td>
<td>397</td>
<td>112</td>
</tr>
<tr>
<td>7</td>
<td>1104</td>
<td>112</td>
</tr>
<tr>
<td>8</td>
<td>1153</td>
<td>958</td>
</tr>
<tr>
<td>9</td>
<td>1153</td>
<td>1226</td>
</tr>
</tbody>
</table>

Notes 1. To bonding pad center

**Ordering Information**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Pad Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP525/D</td>
<td>9</td>
<td>Disable Pad Active</td>
</tr>
<tr>
<td>IMP525/D1</td>
<td>9</td>
<td>Disable Pad Not Active</td>
</tr>
</tbody>
</table>
IMP527
Single Cell Battery Powered EL Lamp Driver, 180V_{PP} Drive

**General Information**

- **Die Thickness:** 25 mils (625 microns)
- **Bond Wire Size:** 1.0 mil (25 microns)
- **Back Side Metal:** None
- **Back Side Potential:** Ground
- **Die Attach Method:** Conductive Adhesive
- **Bond Pad Metal:** Aluminum, 1% Silicon, 1/2% Copper
- **Bond Pad Size:** 100 microns per side
- **Die Size:** 1.35mm x 1.54mm

**Pad Description**

<table>
<thead>
<tr>
<th>Pad Number</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V_{DD}</td>
<td>Positive voltage supply.</td>
</tr>
<tr>
<td>2</td>
<td>R_{SW-OSC}</td>
<td>Switch-mode oscillator frequency setting pad.</td>
</tr>
<tr>
<td>3</td>
<td>C_s</td>
<td>Boost converter storage capacitor pad.</td>
</tr>
<tr>
<td>4</td>
<td>L_x</td>
<td>Inductor pad.</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground pad.</td>
</tr>
<tr>
<td>6</td>
<td>V_{B}</td>
<td>EL lamp drive.</td>
</tr>
<tr>
<td>7</td>
<td>V_{A}</td>
<td>EL lamp drive.</td>
</tr>
<tr>
<td>8</td>
<td>R_{EL-OSC}</td>
<td>EL lamp oscillator frequency setting pad.</td>
</tr>
<tr>
<td>9*</td>
<td>DIS</td>
<td>Disable pad. DIS = HIGH disables chip.</td>
</tr>
</tbody>
</table>

*See Ordering Information table*

**Pad Location**

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<thead>
<tr>
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<th>Y (microns)</th>
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<tr>
<td>1</td>
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<td>1092</td>
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<tr>
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<td>476</td>
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<td>314</td>
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<td>6</td>
<td>397</td>
<td>112</td>
</tr>
<tr>
<td>7</td>
<td>1104</td>
<td>112</td>
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<td>958</td>
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Notes 1. To bonding pad center

**Ordering Information**

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<thead>
<tr>
<th>Part Number</th>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP527/D</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>IMP527/D1</td>
<td>9</td>
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</tr>
</tbody>
</table>
IMP528
High-Voltage EL Lamp Driver, 220V<sub>pp</sub> Drive

**General Information**

<table>
<thead>
<tr>
<th>Pad Number</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt;</td>
<td>Positive voltage supply.</td>
</tr>
<tr>
<td>2</td>
<td>R&lt;sub&gt;SW-OSC&lt;/sub&gt;</td>
<td>Switch-mode oscillator frequency setting pad.</td>
</tr>
<tr>
<td>3</td>
<td>C&lt;sub&gt;S&lt;/sub&gt;</td>
<td>Boost converter storage capacitor pad.</td>
</tr>
<tr>
<td>4</td>
<td>L&lt;sub&gt;X&lt;/sub&gt;</td>
<td>Inductor pad.</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground pad.</td>
</tr>
<tr>
<td>6</td>
<td>V&lt;sub&gt;B&lt;/sub&gt;</td>
<td>EL lamp drive.</td>
</tr>
<tr>
<td>7</td>
<td>V&lt;sub&gt;A&lt;/sub&gt;</td>
<td>EL lamp drive.</td>
</tr>
<tr>
<td>8</td>
<td>R&lt;sub&gt;EL-OSC&lt;/sub&gt;</td>
<td>EL lamp oscillator frequency setting pad.</td>
</tr>
<tr>
<td>9</td>
<td>GND</td>
<td>Ground pad.</td>
</tr>
<tr>
<td>10*</td>
<td>DIS</td>
<td>Disable pad. DIS = HIGH disables chip.</td>
</tr>
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*See Ordering Information table*

**Pad Location**

<table>
<thead>
<tr>
<th>Pad Number</th>
<th>X (microns)</th>
<th>Y (microns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>152</td>
<td>1480</td>
</tr>
<tr>
<td>2</td>
<td>152</td>
<td>1253.5</td>
</tr>
<tr>
<td>3</td>
<td>152</td>
<td>387.75</td>
</tr>
<tr>
<td>4</td>
<td>152</td>
<td>122.5</td>
</tr>
<tr>
<td>5</td>
<td>1198.5</td>
<td>140</td>
</tr>
<tr>
<td>6</td>
<td>1215</td>
<td>395</td>
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<tr>
<td>7</td>
<td>1215</td>
<td>1208.5</td>
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<tr>
<td>8</td>
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<td>998</td>
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</tr>
<tr>
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<td>1553.5</td>
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</tbody>
</table>

Notes 1. To bonding pad center

**Ordering Information**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Disable Pad Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP528/D</td>
<td>10</td>
<td>Disable Pad Active</td>
</tr>
<tr>
<td>IMP528/D1</td>
<td>10</td>
<td>Disable Pad Not Active</td>
</tr>
</tbody>
</table>
IMP560
Power Efficient EL Lamp Driver

**General Information**
- Die Thickness: 25 mils (625 microns)
- Bond Wire Size: 1.0 mil (25 microns)
- Back Side Metal: None
- Back Side Potential: Ground
- Die Attach Method: Conductive Adhesive
- Bond Pad Metal: Aluminum, 1% Silicon, 1/2% Copper
- Bond Pad Size: 100 microns per side
- Die Size: 1.38mm x 1.82mm

**Pad Description**

<table>
<thead>
<tr>
<th>Pad Number</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VDD</td>
<td>Positive voltage supply.</td>
</tr>
<tr>
<td>2</td>
<td>RSW-OSC</td>
<td>Switch-mode oscillator frequency setting pad.</td>
</tr>
<tr>
<td>3</td>
<td>CS</td>
<td>Boost converter storage capacitor pad.</td>
</tr>
<tr>
<td>4</td>
<td>Lx</td>
<td>Inductor pad.</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground pad.</td>
</tr>
<tr>
<td>6</td>
<td>VB</td>
<td>EL lamp drive.</td>
</tr>
<tr>
<td>7</td>
<td>VA</td>
<td>EL lamp drive.</td>
</tr>
<tr>
<td>8</td>
<td>REL-OSC</td>
<td>EL lamp oscillator frequency setting pad.</td>
</tr>
<tr>
<td>9</td>
<td>GND</td>
<td>Ground pad.</td>
</tr>
<tr>
<td>10</td>
<td>DIS</td>
<td>Disable pad. DIS = HIGH disables chip.</td>
</tr>
</tbody>
</table>

*See Ordering Information table*

**Pad Location**

<table>
<thead>
<tr>
<th>Pad Number</th>
<th>X (microns)</th>
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<td>152</td>
<td>387.75</td>
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<tr>
<td>4</td>
<td>152</td>
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<td>1215</td>
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</table>

Notes: 1. To bonding pad center

**Ordering Information**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Pad Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>IMP560/D</td>
<td>10</td>
<td>Disable Pad Active</td>
</tr>
<tr>
<td>IMP560/D1</td>
<td>10</td>
<td>Disable Pad Not Active</td>
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</tbody>
</table>
**IMP803**  
High-Voltage EL Lamp Driver

### General Information
- **Die Thickness:** 25 mils (625 microns)
- **Bond Wire Size:** 1.0 mil (25 microns)
- **Back Side Metal:** None
- **Back Side Potential:** Ground
- **Die Attach Method:** Conductive Adhesive
- **Bond Pad Metal:** Aluminum, 1% Silicon, 1/2% Copper
- **Bond Pad Size:** 100 microns per side
- **Die Size:** 1.38mm x 1.82mm

### Pad Description

<table>
<thead>
<tr>
<th>Pad Number</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VDD</td>
<td>Positive voltage supply.</td>
</tr>
<tr>
<td>2</td>
<td>RSW-OSC</td>
<td>Switch-mode oscillator frequency setting pad.</td>
</tr>
<tr>
<td>3</td>
<td>Cₛ</td>
<td>Boost converter storage capacitor pad.</td>
</tr>
<tr>
<td>4</td>
<td>Lₓ</td>
<td>Inductor pad.</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground pad.</td>
</tr>
<tr>
<td>6</td>
<td>Vₛ</td>
<td>EL lamp drive.</td>
</tr>
<tr>
<td>7</td>
<td>Vₐ</td>
<td>EL lamp drive.</td>
</tr>
<tr>
<td>8</td>
<td>R_EL-OSC</td>
<td>EL lamp oscillator frequency setting pad.</td>
</tr>
<tr>
<td>9</td>
<td>GND</td>
<td>Ground pad.</td>
</tr>
<tr>
<td>10*</td>
<td>DIS</td>
<td>Disable pad. DIS = HIGH disables chip.</td>
</tr>
</tbody>
</table>

* See Ordering Information table

### Pad Location

![Pad Location Diagram]

<table>
<thead>
<tr>
<th>Pad Number</th>
<th>X (microns)</th>
<th>Y (microns)</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>3</td>
<td>152</td>
<td>387.75</td>
</tr>
<tr>
<td>4</td>
<td>152</td>
<td>122.5</td>
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<tr>
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<td>140</td>
</tr>
<tr>
<td>6</td>
<td>1215</td>
<td>395</td>
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<td>7</td>
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<td>122.5</td>
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<tr>
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**Notes**  
1. To bonding pad center

### Ordering Information

<table>
<thead>
<tr>
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<td>Disable Pad Active</td>
</tr>
<tr>
<td>IMP803/D1</td>
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<td>Disable Pad Not Active</td>
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Electroluminescent Lamp Driver Evaluation Board

Introduction

This Application Note introduces an Evaluation Board for IMP EL driver ICs. It is supplied with the IMP803 but can also be used with the IMP560 and IMP525: all 3 have identical pinouts.

EL Lamps and Drivers

An electroluminescent (EL) lamp consists of a phosphor coating on a dielectric that is sandwiched between two conductors. Electrically, it looks like a capacitor. Such a lamp requires drive from a high alternating voltage source in order to emit light. This can be obtained from IMP integrated circuits IMP803, IMP560 and IMP525 that convert low voltages into appropriate high-voltage waveforms.

Small EL lamps exhibit about 2 to 6nF/in². IMP Driver ICs are capable of powering EL lamps that have total equivalent load capacitances up to 30nF, so this works out to a maximum of around 15 square inches. “Powering” in this context means enabling enough light for the application, which can range from LCD backlights (relatively bright in a handheld device) to pagers (medium-bright, in a poorly-lit room), to night-lights (faint, in a dark room).

IMP Driver IC System Diagram

As shown in Figure 1, these ICs contain a high-voltage MOSFET switch, an output H-bridge, and oscillators to drive each. The switch, combined with an external inductor and diode, form a step-up (boost) converter that transforms the input voltage to 45-90 volts across capacitor CS. This, in turn, is switched from one side of the load (the EL lamp) to the other by a commutating bridge, driven by its own oscillator. This action causes the lamp to experience twice the CS value (i.e. 90-180 volts peak-to-peak) with no DC component.

A typical application uses a switch frequency of 80kHz and bridge commutation frequency of 360Hz. These frequencies are controllable via external resistors; RSW for the boost converter and REL for the output driver. REL influences brightness, color and EL lamp life. RSW controls converter efficiency. Both affect power consumption.

Figure 1. Circuitry in gray is on-chip.
Driver Variations

The IMP803, 560 and 525 have an internal regulating circuit (see Figure 2), that is useful where $V_{IN}$ is expected to change considerably, as with an aging battery: as $V_{IN}$ falls, $V_{OUT}$ (and brightness) will remain substantially unaffected.

Table 1 is a general comparison of IMP EL Lamp drivers. It facilitates choices based on number of batteries, size of display, and regulation. Required display brightness will also need to be factored into the choice.

Table 1. General Characteristics of IMP EL Lamp Drivers

<table>
<thead>
<tr>
<th>Device</th>
<th>$V_{IN}$</th>
<th>$V_{OUT}$</th>
<th>Regulated Output</th>
<th>Max. Switch R(on)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMP803</td>
<td>2.4 – 6.5V</td>
<td>180Vpp</td>
<td>Yes</td>
<td>8Ω</td>
</tr>
<tr>
<td>IMP560</td>
<td>2.4 – 6.5V</td>
<td>120Vpp</td>
<td>Yes</td>
<td>8Ω</td>
</tr>
<tr>
<td>IMP525</td>
<td>0.9 – 2.5V</td>
<td>112Vpp</td>
<td>Yes</td>
<td>15Ω</td>
</tr>
</tbody>
</table>

Basic Circuit, Plus Variations

In normal operation, $V_{DD}$ is one or two 1.5V cells and L1 is a tiny ferrite-bobbin inductor. $R_{SW}$ and $R_{EL}$ control their respective oscillators. If a logic-controllable shutdown is desired, $R_{SW}$ may be switched between $V_{DD}$ and GND ($I_{DDQ} = 1\mu A$ max.). Conversely, if shutdown is via $V_{DD}$, $R_{SW}$ should then be connected to $V_{DD}$ as shown by the dotted line in Figure 3.

$R_{CL}$ is included to protect the bridge against peak currents during commutation. A value of 500Ω to 2kΩ is suitable.

In use, the inductor current can reach several tens of milliamperes, so in single-battery applications it is recommended that the low-current shutdown capability of the driver IC be utilized. This is done by connecting $R_{SW}$ (point A on the schematics) to either $V_{DD}$ (ON) or GND (OFF). With power source(s) connected, shutdown (standby) current is typically much lower than 1μA.
Reducing Component Count

Having said that keeping $R_{CL}$ is a good idea, it is true that removing as many components as possible may also be desirable. For the IMP803, $R_{EL}$ and $R_{SW}$ may be combined as shown in Figure 4. Varying $R_{EL}$ causes a visible change in brightness and color, but a similar variation in $R_{SW}$ (affecting oscillator frequency and power consumption) is much less noticeable. Combining the two is thus a valid way to save a resistor. The bypass capacitor $C_{BP}$ (IMP525 only) reduces display flicker in noisy environments, such as when there is no ground plane.

Using the circuit in Figure 5, one can utilize an available $V_{IN}$ that is higher or lower than the allowable $V_{DD}$. The logic shutdown may also be separated from $V_{DD}$. Such arrangements are helpful when the inductor supply is too low for the IC, or the display size requires a voltage that is too high for the IC.

A higher $V_{IN}$ will need a higher switching frequency to keep the inductor out of saturation. In all cases, note the presence of HIGH VOLTAGE!

---

**Figure 4.** Using $R_{SW}$ to supply current for both switch and EL oscillators, and also serve as a low-current on/off switch (IMP803 only).

**Figure 5.** General Circuit, where chip $V_{DD}$, on/off logic and $V_{IN}$ are all different.
Evaluation Board

The ELD002 is a PC board for evaluation and experimentation purposes. More compact arrangements are easily achieved by using surface-mounted components exclusively. The various possible connections mirror the options discussed in the data sheet and the Application Note.

The two dark patches are the connections for the EL lamp which are made using conductive double-sided tape. The display itself is held down with ordinary double-sided tape. Taping is advantageous for several reasons, among which are that lamps with staked connecting terminals generally cost more, and they are a possible site for mechanical (and thus electrical) failure.

As a general precaution, note that HIGH VOLTAGE exists on the board; around 180V or so. The current level is low so there is no danger, except possible pain if a tender skin area or open cut contacts the HV sections.

There are extra holes for capacitors (if needed), and the hole spacings are wide enough to accommodate 1/4W resistors. Corner mounting holes have also been provided.

Figure 6. Evaluation Board Layout and Schematic.
Some Battery Considerations

To keep the board light in weight, a Li-Mn power source was selected. When energized, the drain from the circuit is around 22mA, thus the CR battery chemistry is preferred over the BR for its superior pulse performance. If long-term continual illumination is anticipated and space is not an issue, alkaline batteries may be more economical.

With the IMP803 and 560μH inductor supplied, regulation begins at about 3-3.5V, but display illumination appears virtually unchanged above 2.7V. When choosing the battery chemistry, it is a good idea to match the cell “plateau” voltages to this. For example, a typical NiCad plateau is 1.2V under load, so more than 2 cells would be needed. Alkaline plateaus are somewhat higher, and they differ with size, shape and duty, so 2 cells could suffice. Li-Mn coin cells have their voltage plateau under load at about 2.85 volts. They can drop lower, but they also return to close to 3V when the load is removed.

Additional Points

1) To experiment with the Figure 4 scheme, a jumper may be run from the rightmost pad of \( R_{EL} \) to the leftmost pad of \( C_{BP} \) (with the + above it). Start with an \( R_{SW} \) of 750kΩ. Short leads and a ground plane are more critical in this arrangement.

2) \( C_S \) should be 10nF - 100nF.

3) The IMP803, IMP560 and IMP525 datasheets show performance with different inductors. For example, high-voltage regulation is reached earlier with lower L, but this requires more current. This may be partially offset by adjustment of the oscillator resistors.

4) To experiment with multiple supplies, the appropriate jumpers may be removed.

5) The inclusion of \( R_{CL} \) should be stressed: while 500Ω to 10kΩ has been used, 2kΩ is the best all-around value.

Layout Rules for Other Arrangements

1) A ground plane is recommended to keep stray high frequencies confined. In a very small area, the need for a ground plane may be nil. A totally surface-mount arrangement would make such a plane difficult anyway.

2) Locate high voltages away from the high-impedance elements \( R_{EL} \) and \( R_{SW} \).

3) Make sure that \( C_S \) has a rating of at least 100V.

4) The diode should have good reverse-recovery characteristics (the general-purpose 1N4148 is adequate) and should be rated for pulsed BV > 100V for the IMP803, and pulsed BV > 75V for the IMP560 and IMP525.

5) Shutdown by a logic-level signal is possible by connecting \( R_{SW} \) to ground (\( R_{SW} \) is normally connected to \( V_{DD} \)). This on/off logic uses only 1μA max. when connected at this location.

7) Required voltage ratings for the capacitors other than \( C_S \) are flexible, and need only reflect actual stresses plus a safety margin.
**Bill of Materials**

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistors (±5%)</td>
<td>See Table, below</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacitors (±20%)</td>
<td>See Table, below</td>
<td>Murata</td>
<td>RPE121/122 Series</td>
</tr>
<tr>
<td>Switch</td>
<td>SPST, momentary</td>
<td>Panasonic</td>
<td>P8008S</td>
</tr>
<tr>
<td>Battery</td>
<td>3.0V Li-Mn Coin</td>
<td>Sony</td>
<td>CR2450-HE4</td>
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<td></td>
<td></td>
<td>Panasonic</td>
<td>CR2354-IGU</td>
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<tr>
<td>Inductor</td>
<td>L1 = 560µH</td>
<td>Murata</td>
<td>LQH4N561K04</td>
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<td>Diode</td>
<td>D1 = 1N4148</td>
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<tr>
<td>Lamp</td>
<td>1.3” x 2.05”</td>
<td>MetroMark or other</td>
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<tr>
<td>Conductive Tape</td>
<td>Connects display</td>
<td>Adhesives Research</td>
<td>ARclad 801</td>
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<tr>
<td>Double-Sided Tape</td>
<td>Holds display down</td>
<td>3M</td>
<td>Type 665</td>
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</table>

**Key to Components and Ratings**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Function</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSW</td>
<td>30kΩ to 3MΩ</td>
<td>Sets switch osc. frequency.</td>
<td>Decrease R to increase frequency.</td>
</tr>
<tr>
<td>REL</td>
<td>500kΩ to 10MΩ</td>
<td>Sets bridge osc. frequency.</td>
<td>Decrease R to increase frequency.</td>
</tr>
<tr>
<td>RCL</td>
<td>500Ω to 2kΩ</td>
<td>Limits output current.</td>
<td>Protects IC.</td>
</tr>
<tr>
<td>CS</td>
<td>0.01µF to 0.1µF, 100V</td>
<td>Stores high voltage.</td>
<td>Use low values for large lamps.</td>
</tr>
<tr>
<td>CBATT</td>
<td>0.1µF, 10V</td>
<td>Supply bypass.</td>
<td>Keeps supply impedance low.</td>
</tr>
<tr>
<td>CBP</td>
<td>1nF, 10V</td>
<td>Lowers noise at RSW.</td>
<td>IMP525 only.</td>
</tr>
<tr>
<td>CIN</td>
<td>0.1µF to 22µF</td>
<td>Supply bypass.</td>
<td>Keeps supply impedance low.</td>
</tr>
<tr>
<td>L1</td>
<td>100µH to 1mH</td>
<td>Stores energy.</td>
<td>Small L, high f increases Vout.</td>
</tr>
<tr>
<td>D1</td>
<td>100V, 10mA (1N4148)</td>
<td>Passes energy from L to CS.</td>
<td>Use fast recovery type.</td>
</tr>
</tbody>
</table>

**APPENDIX: Introduction to EL Lamps**

Chemical compounds, called phosphors, glow when energy is applied to them. This excitation energy can come from conducted or radiated electrons, or an electric field. A common example of this process is found in the emitted (radiated) electrons that impinge on the dots and stripes of color monitors and TVs, whose phosphors emit everything from pure colors to white light, depending on their formulations.

Backlights and lamps generally are simpler, employing a manganese-activated zinc sulfide phosphor (ZnS:Mn) that is excited by a high-voltage (> 40V) AC electric field (DC can shorten the lamp life). Fabrication involves depositing the phosphor as a thin film onto a BaTiO3 dielectric between conducting planes, like a capacitor: one of the planes is the transparent conductor, indium tin oxide (ITO). The lamp color depends on phosphor formulation, but also on its physical realization (i.e. encapsulation, resins, dyes, etc.), plus the characteristics of the drive circuitry.

The IMP line of drivers is targeted mainly at applications like backlight EL and stand-alone pre-printed or segmented lamps. Backlights are used with the Liquid Crystal Displays (LCDs) found in cellular telephones, pagers, Personal Digital Assistants (PDAs), and general-purpose local lighting applications where low power consumption without heat is important (e.g. airline cockpits, medical instrumentation).

The excitation required for lamps ranges from tens to hundreds of volts, at frequencies from 60Hz to a few kHz. Each display has an optimum combination depending on size, color, efficiency and desired brightness.

In general, the changes in brightness with frequency and voltage are nearly linear. These facts allow tradeoffs. For example, if going above a certain voltage is not allowed, an increase in drive frequency may achieve the same result.
Introduction

These Demonstration Boards provide a platform for demonstration and experimentation with IMP’s EL lamp drivers IMP803, IMP560 and IMP525. The PC board has space for all of the components required for a complete application circuit. In addition, compact size facilitates their use in prototype systems.

For normal operation, the enable pad (EN), the VDD pad and the VL pad are all connected to the positive supply voltage. If the board is located far from the supply, a 10µF/10V tantalum capacitor from VL to GND should be used to keep supply impedance low (This cap, or its equivalent, is normally present in a manufactured circuit). Also, better noise immunity may be achieved by utilizing separate wires for the VL and VDD connections.

The CBATT capacitor is used to bypass the supply pin of the IC. The CSW capacitor (IMP525 only) is utilized to reduce noise on the high impedance RSW pin. CSW should never be greater than 100pF since this can result in instability of the 525’s internal oscillator.

The layout was designed to reduce the effects of noise through use of a ground plane and by separation of the high-current components (inductor, diode, and reservoir capacitor) from the high-impedance portion of the circuit (the high-value frequency-setting resistors). Additionally, the lengths of high-current traces were minimized.

If parts are replaced or exchanged by hand-soldering, care should be taken to thoroughly clean the residual flux from the board surface. Otherwise, resultant leakage currents may prevent proper operation of the part. The tight spacing and high impedances of input nodes on the PCB exacerbate this effect. The predominant impact of PCB leakage is a shift in the switch and commutation frequencies away from their designed values due to leakage currents from the RSW and REL pins.

Figure 1. Top View of Printed Circuit Board
Figure 2. Demonstration Board Schematic.

Table 1. Bill of Materials (use as required)

<table>
<thead>
<tr>
<th>Component</th>
<th>Package</th>
<th>Manufacturer and Part Number</th>
<th>IMP803</th>
<th>IMP560</th>
<th>IMP525</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{SW}$</td>
<td>0603</td>
<td>Any</td>
<td>750kΩ</td>
<td>750kΩ</td>
<td>1MΩ</td>
</tr>
<tr>
<td>$R_{EL}$</td>
<td>0603</td>
<td>Any</td>
<td>2MΩ</td>
<td>2MΩ</td>
<td>1MΩ</td>
</tr>
<tr>
<td>$R_{CL}$</td>
<td>0603</td>
<td>Any</td>
<td>510Ω</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>$L_1$</td>
<td>1812</td>
<td>Murata LQH4N561K04</td>
<td>560μH</td>
<td>560μH</td>
<td>560μH</td>
</tr>
<tr>
<td>$C_S$</td>
<td>0805</td>
<td>NovaCap 0805B683K101NT</td>
<td>68nF/100V</td>
<td>68nF/100V</td>
<td>68nF/100V</td>
</tr>
<tr>
<td>$D_1$</td>
<td>SOD80</td>
<td>4148-type</td>
<td>100V</td>
<td>75V</td>
<td>75V</td>
</tr>
<tr>
<td>$C_{BATT}$</td>
<td>0603</td>
<td>Any</td>
<td>100nF</td>
<td>100nF</td>
<td>100nF</td>
</tr>
</tbody>
</table>

Table 2. Component Description Table

<table>
<thead>
<tr>
<th>Component</th>
<th>Function</th>
<th>Comments</th>
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<tbody>
<tr>
<td>$R_{SW}$</td>
<td>Sets switch frequency</td>
<td>Decreasing R increases frequency.</td>
</tr>
<tr>
<td>$R_{EL}$</td>
<td>Sets commutation frequency</td>
<td>Decreasing R increases frequency.</td>
</tr>
<tr>
<td>$R_{CL}$</td>
<td>Limits output current</td>
<td>Optional external part: protects bridge if $V(C_S) &gt; 80V$ (IMP803 only).</td>
</tr>
<tr>
<td>$L_1$</td>
<td>Boost inductor</td>
<td>Delivers energy to $C_S$.</td>
</tr>
<tr>
<td>$C_S$</td>
<td>Reservoir capacitor</td>
<td>Delivers energy to commutating bridge.</td>
</tr>
<tr>
<td>$C_{SW}$</td>
<td>Noise reduction capacitor</td>
<td>Optional, use if flickering is observed (IMP525 only).</td>
</tr>
<tr>
<td>$C_{BATT}$</td>
<td>Supply bypass capacitor</td>
<td>Optional (use if missing from external circuit)</td>
</tr>
<tr>
<td>$D_1$</td>
<td>Catch diode</td>
<td>Fast recovery diode recommended. Observe $B_{REV}$.</td>
</tr>
</tbody>
</table>
### Package Dimensions

**MicroSO (8-Pin)**

<table>
<thead>
<tr>
<th>Parts/Reel</th>
<th>3000</th>
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</table>

**SO (8-Pin)**

<table>
<thead>
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<th>Parts/Reel</th>
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### Package Information

**SO (8-Pin)**

<table>
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<tr>
<th>Inches</th>
<th>Millimeters</th>
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<tr>
<td></td>
<td>Min</td>
</tr>
<tr>
<td>A</td>
<td>0.053</td>
</tr>
<tr>
<td>A1</td>
<td>0.004</td>
</tr>
<tr>
<td>B</td>
<td>0.013</td>
</tr>
<tr>
<td>C</td>
<td>0.007</td>
</tr>
<tr>
<td>E</td>
<td>0.150</td>
</tr>
<tr>
<td>H</td>
<td>0.228</td>
</tr>
<tr>
<td>L</td>
<td>0.016</td>
</tr>
<tr>
<td>D</td>
<td>0.189</td>
</tr>
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</table>

**MicroSO (8-Pin)**

<table>
<thead>
<tr>
<th></th>
<th>Inches</th>
<th>Millimeters</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>A</td>
<td>0.0020</td>
<td>0.0059</td>
</tr>
<tr>
<td>A1</td>
<td>0.0295</td>
<td>0.0374</td>
</tr>
<tr>
<td>b</td>
<td>0.0098</td>
<td>0.0157</td>
</tr>
<tr>
<td>C</td>
<td>0.0051</td>
<td>0.0091</td>
</tr>
<tr>
<td>D</td>
<td>0.1142</td>
<td>0.1220</td>
</tr>
<tr>
<td>e</td>
<td>0.0256 BSC</td>
<td>0.65 BSC</td>
</tr>
<tr>
<td>E</td>
<td>0.193 BSC</td>
<td>4.90 BSC</td>
</tr>
<tr>
<td>E1</td>
<td>0.1142</td>
<td>0.1220</td>
</tr>
<tr>
<td>L</td>
<td>0.0157</td>
<td>0.0276</td>
</tr>
<tr>
<td>a</td>
<td>0°</td>
<td>6°</td>
</tr>
</tbody>
</table>
Embossed Tape — Constant Dimensions

<table>
<thead>
<tr>
<th>Tape Size</th>
<th>D</th>
<th>E</th>
<th>P0</th>
<th>P2</th>
<th>T Max.</th>
<th>T1 Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8mm</td>
<td>1.5 ± 0.10 (0.59 ± 0.004)</td>
<td>1.75 ± 0.10 (0.069 ± 0.004)</td>
<td>4.0 ± 0.10 (0.157 ± 0.004)</td>
<td>2.0 ± 0.05 (0.079 ± 0.002)</td>
<td>0.600 (0.024)</td>
<td>0.10 (0.004)</td>
</tr>
<tr>
<td>12mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Embossed Tape — Variable Dimensions

<table>
<thead>
<tr>
<th>Tape Size</th>
<th>A0, B0, K0</th>
<th>B1 See Note 4</th>
<th>D1 See Note 3</th>
<th>F</th>
<th>T2</th>
<th>P1</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>8mm 1/2 Pitch</td>
<td>See Note 1</td>
<td>4.55 (0.179)</td>
<td>1.0 (0.039)</td>
<td>3.5 ± 0.05 (0.138 ± 0.002)</td>
<td>2.0 ± 0.10 (0.079 ± 0.004)</td>
<td>8.0 ± 0.3 (0.315 ± 0.012)</td>
<td></td>
</tr>
<tr>
<td>8mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12mm</td>
<td>See Note 1</td>
<td>8.2 (0.323)</td>
<td>1.5 (0.059)</td>
<td>5.5 ± 0.05 (0.217 ± 0.002)</td>
<td>6.5 Max. (0.256)</td>
<td></td>
<td>12.0 ± 0.30 (0.472 ± 0.012)</td>
</tr>
<tr>
<td>12mm Double Pitch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: 1. A0, B0 and K0 are determined by the maximum dimensions to the ends of the terminals extending from the component body and / or the body dimensions of the component. The clearance between the ends of the terminals or body of the component to the sides and depth of the cavity (A0, B0 and K0) must be within 0.05mm (0.002) minimum and 0.50mm (0.020) maximum. The clearance allowed must also prevent rotation of the component within the cavity of not more than 20 degrees (see Component Rotation).
2. Tape with components shall pass around radius.
3. The embossment hole location shall be measured from the spocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.
4. B1 dimension is a reference dimension for tape feeder clearance only.
Component Rotation

- 20° Maximum Component Rotation
- Typical Component Cavity Center Line
- Typical Component Center Line

Bending Radius

- R Min.

Tape Camber (Top View)

- 100mm (3.937)
- 1mm Max.
- 250mm (9.843)
- 1mm (.039) Max.

Allowable camber to be 1mm/100mm nonaccumulative over 250mm.

Tape Leader and Trailer Dimensions

- End
- Carrier Tape
- Components
- Start
- Cover Tape

- 160mm (6.30) Min.
- 390mm (15.35) Min.
- 560mm (22.05) Max.

User Direction of Feed
Reel Dimension

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8mm</td>
<td>330(12.992)</td>
<td>1.5(0.059)</td>
<td>13.0 ± 0.20(0.512 \pm 0.008)</td>
<td>20.2(0.795)</td>
<td>50(1.969)</td>
<td>(8.4 + 1.5) (0.331 + 0.059)</td>
<td>14.4(0.567)</td>
<td>7.9 Min.(0.311) 10.9 Max.(0.0429)</td>
</tr>
<tr>
<td>12mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(12.4 + 2.0) (0.488 + 0.078)</td>
<td>18.4(0.724)</td>
<td>11.9 Min.(0.469) 15.4 Max.(0.607)</td>
</tr>
</tbody>
</table>

Tape Layout

User Direction of Feed
IMP Sales Offices and Representatives

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Colleville, PA
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URL: www.impweb.com

Vermont
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URL: www.astrorep.com

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Bellevue, WA
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Astrorep Mid Atlantic, Inc.
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Products are distributed in the U.S. by Jaco Electronics, Inc.

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Fax: 46.8.744.7922
From Oakland International Airport
Go South on 880 and turn right at the Montague Expressway exit, move left out of the car pool lane. Turn left on Zanker Road and then turn right on Daggett Drive.

From San Francisco International Airport
Go South on 101 to the Montague Expressway exit (east). Turn right on Zanker Road and then turn right on Daggett Drive.

From San Jose International Airport
From Terminal Drive go to Airport Blvd. From Airport Blvd., turn onto Airport Pkwy. (Airport Pkwy becomes Brokaw Road after 101). Turn left on North First Street, then turn right on Daggett Drive.

For Additional Directions
408-432-9100
Quality at IMP - Our Policy

Quality Priority
Quality in everything we do is a fundamental IMP commitment. Quality may not be sacrificed for any other priority. Before any action is taken, the effect on quality as seen by employees and by customers must be considered.

Product Quality Conformance
Products and services for our customers will conform to all requirements. Products will meet performance specifications. Services will be complete, meet described requirements, and will be in a format appropriate for the customer’s use. If a specification cannot be met in full, the customer will be advised and a new specification will be negotiated.

Product and Process Quality Improvement
All processes, manufacturing, manufacturing planning, customer service, product design and design of manufacturing processes shall utilize Total Quality Management concepts including Statistical Process Control techniques and designed experiments to ensure continual improvement of products and services.

Employee Responsibility
Each employee is responsible for performing their work correctly and completely. This responsibility for quality performance applies to all design work, development work, manufacturing work and to all supporting work. It applies to all employee levels. It cannot be abandoned or delegated. No one else can take responsibility.

IMP’s Commitment of Support
IMP will provide the tools, the training, and the time necessary for employees to meet their responsibilities.

Employee Participation
IMP encourages all employees to take part in the open discussion, analysis and resolution of problems through participation in quality and productivity teams or through personal suggestions.
Quality at IMP - Our Policy

DET NORSKE VERITAS
QUALITY SYSTEM CERTIFICATE

Certificate No. 99-HOU-AQ-8474

This is to certify that the Quality System of

IMP INC.

at

2830 North First Street, San Jose, CA 95134-2071 USA

Has been found to conform to Quality Standard:

ISO 9001, 1994

This Certificate is valid for the following products/service ranges:

DESIGN AND MANUFACTURE OF ANALOG AND MIXED-SIGNAL INTEGRATED CIRCUITS AND WAFER FABRICATION SERVICES

Place and date:
Houston, Texas; 24 September 1999

This certificate is valid until:
12 August 2002

Initial Certification Date:
08 August 1996

Lack of fulfillment of conditions as set out in the Appendix may render this certificate invalid.

DET NORSKE VERITAS CERTIFICATION, INC., 10540 Park Ten Place, Suite 100, Houston, TX 77094 USA TEL: (281) 721-6600 FAX: (281) 721-6903
IMP offers higher performance, lower-power microprocessor supervisors that are pin compatible with devices from Dallas Semiconductor and Maxim Integrated Products. For the latest information visit [www.impweb.com](http://www.impweb.com) or send specific requests to info@impinc.com.

### µP Supervisor Products: Low Power Alternatives to Maxim

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<th>Part Number</th>
<th>Threshold Voltage (V)</th>
<th>Backup Battery Switch</th>
<th>Watchdog Timer</th>
<th>Power Fail Monitor</th>
<th>Manual Reset</th>
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### Block Diagrams

**IMP690A, IMP692A, IMP802L, IMP802M and IMP805L**

**IMP705, IMP706 and IMP813L**

**IMP707 and IMP708**
### µP Supervisor Products: Low Power Alternatives to Dallas Semiconductor

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<th>RESET Voltage (V)</th>
<th>RESET Tolerance (%)</th>
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<th>8-Pin SO Package</th>
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*T indicates Tape and Reel.*
USB Power Switches

IMP offers a full complement of Universal Serial Bus (USB) power switches that are higher-performance equivalents to devices from Micrel.

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<th>Part Number</th>
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<th>Open-Load Detection Function</th>
<th>Maximum &quot;ON&quot; Resistance (mΩ)</th>
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## Sample Requests and New Product Updates

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Fax to

408.434.0335