NIPPON PRECISION CIRCUITS INC.

SM8610CV

Laser Switching Driver IC

OVERVIEW

The SM8610CV is a portable CD player laser driver IC. It uses a laser switching drive that reduces the laser power dissipation, thereby reducing data read current consumption and extending battery life significantly, when compared with existing devices which use a constant-current laser control method with corresponding high dissipation which places limits on battery life.

FEATURES

- 2.4V supply voltage
- Laser switching driver built-in
- Laser switching frequency range: 8.6 to 26MHz
- Switching pulsewidth duty adjustable
- Laser drive maximum current adjustable
- Laser control loop gain adjustable
- Power-save mode (Laser driver current stop function)
- Package: 16-pin VSOP

APPLICATIONS

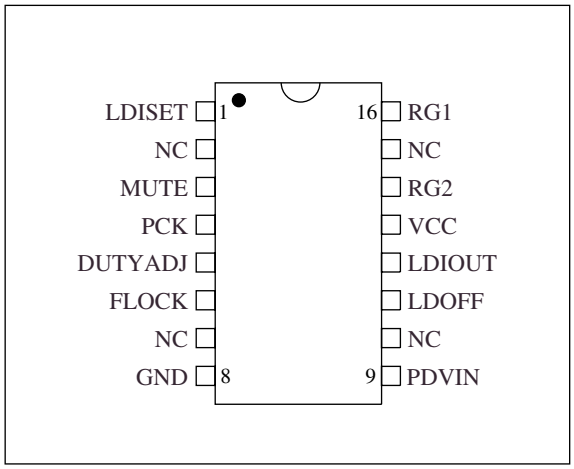
- Portable CD player

ORDERING INFORMATION

Device	Package
SM8610CV	16-pin VSOP

PINOUT

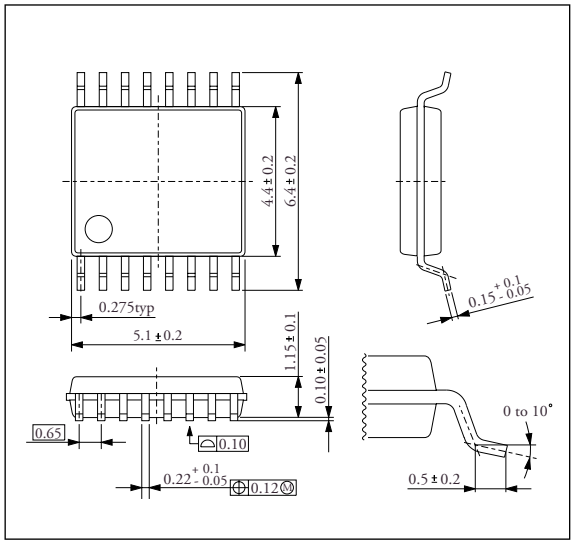
(Top view)



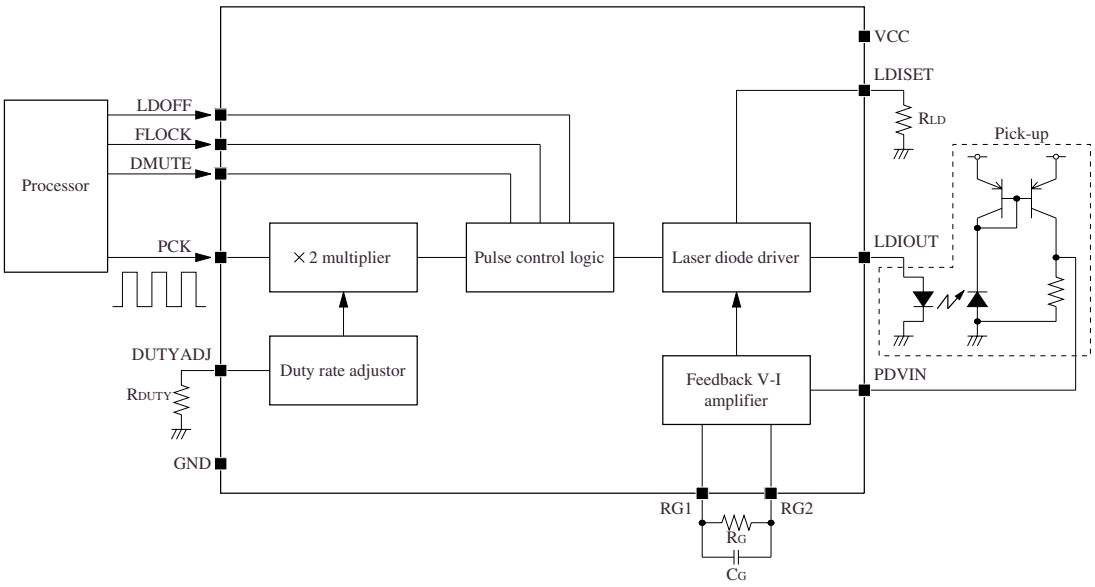
PACKAGE DIMENSIONS

(Unit: mm)

Weight: 0.07g



BLOCK DIAGRAM



PIN DESCRIPTION

<table>
<tr><th>Number</th><th>Name</th><th>i/o</th><th>Description</th></tr>
<tr><td>1</td><td>LDISET</td><td>o</td><td>Laser drive maximum current setting resistor connection</td></tr>
<tr><td>2</td><td>NC</td><td>–</td><td>No connection (must be open)</td></tr>
<tr><td>3</td><td>MUTE</td><td>ip</td><td>Muting signal
<table>
<tr><th>DMUTE</th><th>Laser drive state</th></tr>
<tr><td>L</td><td>Laser switching drive</td></tr>
<tr><td>H</td><td>Laser constant-current drive</td></tr>
</table></td></tr>
<tr><td>4</td><td>PCK</td><td>i</td><td>Data extract clock input</td></tr>
<tr><td>5</td><td>DUTYADJ</td><td>o</td><td>Laser switching pulse duty adjust</td></tr>
<tr><td>6</td><td>FLOCK</td><td>ip</td><td>Focus servo lead-in signal
<table>
<tr><th>FLOCK</th><th>Laser drive state</th></tr>
<tr><td>L</td><td>Laser constant-current drive</td></tr>
<tr><td>H</td><td>Laser switching drive</td></tr>
</table></td></tr>
<tr><td>7</td><td>NC</td><td>–</td><td>No connection (must be open)</td></tr>
<tr><td>8</td><td>GND</td><td>–</td><td>Ground connection</td></tr>
<tr><td>9</td><td>PDVIN</td><td>i</td><td>Laser current monitor voltage input</td></tr>
<tr><td>10</td><td>NC</td><td>–</td><td>No connection (must be open)</td></tr>
<tr><td>11</td><td>LDOFF</td><td>ip</td><td>Laser drive current stop signal input
<table>
<tr><th>LDOFF</th><th>Laser drive state</th></tr>
<tr><td>L</td><td>Laser drive OFF
In this state, the SM8610CV is in power-save mode.</td></tr>
<tr><td>H</td><td>Laser drive ON</td></tr>
</table></td></tr>
<tr><td>12</td><td>LDIOUT</td><td>o</td><td>Laser drive current output</td></tr>
<tr><td>13</td><td>VCC</td><td>–</td><td>2.4V supply voltage</td></tr>
<tr><td>14</td><td>RG2</td><td>o</td><td>Laser control loop gain setting resistor connection</td></tr>
<tr><td>15</td><td>NC</td><td>–</td><td>No connection (must be open)</td></tr>
<tr><td>16</td><td>RG1</td><td>o</td><td>Laser control loop gain setting resistor connection</td></tr>
</table>

ip: Built-in pull-down resistor

SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	– 0.5 to 7.0	V
Input voltage	V_{IN}	– 0.5 to V_{CC} + 0.5	V
Input current	I_{IN}	– 3.0 to + 3.0	mA
Operating temperature	T_{OPR}	– 20 to 70	°C
Storage temperature	T_{STG}	– 40 to 125	°C
Power dissipation	P_W	96	mW

DC Electrical Characteristics

V_{CC} = 2.3V, Ta = + 25 °C unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit	Test level
			min	typ	max		
Guaranteed operating supply voltage	V_{CC}		2.3	2.5	–	V	I
Current consumption	I_{CC1}	V_{CC} = 2.5V, PDVIN = 0V, R_{LDISET} = 47kΩ, R_G = 33kΩ, LDOFF = HIGH, Excluding LDIOUT current	–	4.9	6.2	mA	I
	I_{CC2}	LDOFF = LOW	–	–	30	µA	I

Input Specifications

V_{CC} = 2.3V, Ta = + 25 °C unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
PCK HIGH-level voltage	V_{IHPCK}		$V_{CC} \times 0.7$	–	–	V
PCK LOW-level voltage	V_{ILPCK}		–	–	$V_{CC} \times 0.3$	V
PCK HIGH-level sink current	I_{HPCK}		–	–	20	µA
LDOFF HIGH-level voltage	$V_{IHLDOFF}$		$V_{CC} \times 0.7$	–	–	V
LDOFF LOW-level voltage	$V_{ILLDOFF}$		–	–	$V_{CC} \times 0.3$	V
LDOFF HIGH-level sink current	I_{HLDOFF}		–	–	20	µA
FLOCK HIGH-level voltage	$V_{IHFLOCK}$		$V_{CC} \times 0.7$	–	–	V
FLOCK LOW-level voltage	$V_{ILFLOCK}$		–	–	$V_{CC} \times 0.3$	V
FLOCK HIGH-level sink current	I_{HFLOCK}		–	–	20	µA
MUTE HIGH-level voltage	$V_{IHDMUTE}$		$V_{CC} \times 0.7$	–	–	V
MUTE LOW-level voltage	$V_{ILDMUTE}$		–	–	$V_{CC} \times 0.3$	V
MUTE HIGH-level sink current	I_{HDMUTE}		–	–	20	µA

Electrical Characteristics

V_{CC} = 2.3V, Ta = + 25 °C unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit	Test level
			min	typ	max		
PCK minimum input frequency	f_{PCKMIN}		–	–	4.3	MHz	I
PCK maximum input frequency	f_{PCKMAX}		13	–	–	MHz	I
Laser switching frequency range	f_{LD}		8.6	–	26	MHz	I
LDOFF response time 1	t_{LDOFF1}	LDOFF HIGH → LOW	–	12	15	µs	III
LDOFF response time 2	t_{LDOFF2}	LDOFF LOW → HIGH	–	–	15	µs	III
FLOCK response time 1	t_{FLOCK1}	FLOCK HIGH → LOW DMUTE = LOW	–	–	15	ns	III
FLOCK response time 2	t_{FLOCK2}	FLOCK LOW → HIGH DMUTE = LOW	–	–	15	ns	III
DMUTE response time 1	t_{DMUTE1}	DMUTE HIGH → LOW FLOCK = HIGH	–	–	15	ns	III
DMUTE response time 2	t_{DMUTE2}	DMUTE LOW → HIGH FLOCK = HIGH	–	–	15	ns	III
LDIOUT maximum output current	I_{LDMAX}	R_{LD} = 27kΩ, R_G = 33kΩ, V(PDVIN) = DC, 0V fixed	40	–	–	mA	I
LDIOUT rise time	$t_{rLDIOUT}$		–	–	15	ns	III
LDIOUT fall time	$t_{fLDIOUT}$		–	–	15	ns	III
LDISET voltage	V_{LDISET}		–	1/3V_{CC}		V	I
PDVIN convergence voltage	V_{PDVIN}	R_G = 33kΩ, V_{CC} = 2.5V	150	–	180	mV	I
PDVIN input impedance	Z_{PDVIN}		1	–	–	MΩ	I
APC loop cutoff frequency	f_{APC}	R_G = 3kΩ, C_G = 1000pF	–	53	–	kHz	I
Minimum duty ratio	Dutymin	PCK = 13MHz, R_{DUTY} = 15kΩ	–	26	–	%	I
Maximum duty ratio	Dutymax	PCK = 4.3MHz, R_{DUTY} = 3kΩ	–	69	–	%	III
Minimum LD pulsewidth	T_{LDON}		–	15	–	ns	III

Note 1) LDOFF has internal pull-down resistor.
Note 2) FLOCK has internal pull-down resistor.
Note 3) DMUTE has internal pull-down resistor.
Note 4) LDISET is in high-impedance state when LDOFF is HIGH.
Note 5) DUTYADJ is in high-impedance state when LDOFF is HIGH.

Test level description

Test level I	100% of devices tested at 25°C
Test level II	Samples tested only
Test level III	Specifications guaranteed according to design and evaluation tests.
Test level IV	Parameter typical values only guaranteed.

FUNCTIONAL DESCRIPTION

LD Driver Control

The laser diode is controlled by 3 logic-level input signals: LDOFF, FLOCK, and MUTE. When LDOFF is HIGH, the laser diode driver is ON, and the mode is controlled by FLCOK and MUTE. When LDOFF is LOW, the laser diode drive is OFF and the IC is in power-save mode (LDIOUT output current = 0mA).

The LD has a chopper drive input when FLOCK is HIGH and MUTE is LOW.

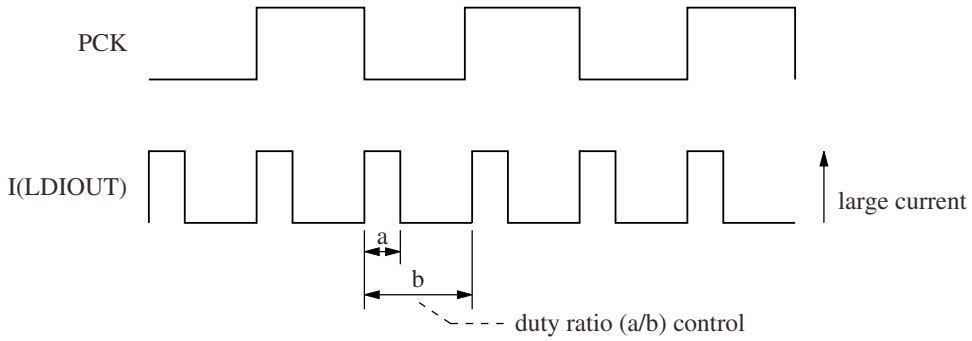
Table 1. Laser diode control signals

LDOFF	FLOCK	MUTE	Laser drive state
H	L	L	LDIOUT constant-current output
H	L	H	LDIOUT constant-current output
H	H	L	LDIOUT chopper current output
H	H	H	LDIOUT constant-current output
L	×	×	LDIOUT = 0mA (power-save mode)

Note) × : Don't care.

Pulsewidth Adjust and Frequency Multiplication Function

The SM8610CV internal waveform processor multiplies the PCK input signal frequency by 2, and the pulse-width of this signal can be adjusted to control the duty ratio.



The output pulse current (LD chopper signal) on LDIOUT is automatically adjusted to maintain roughly constant duty ratio, even for changes in frequency. The LD chopper signal duty ratio can be adjusted by changing the resistance R_{DUTY} connected between the DUTYADJ and GND pins, as given by the following equation.

$$dutyratio = \left(1 - \frac{\frac{3}{2}V(DUTYADJ)}{\frac{1}{2}VCC(\approx Vth)}\right) \times 100 = \frac{22[\mathrm{k\Omega}] - 2 \times R_{DUTY}}{R_{DUTY} + 22[\mathrm{k\Omega}]} \times 100\ [\%]$$

$$V(DUTYADJ) = \frac{R_{DUTY}}{R_{DUTY} + 22[\mathrm{k\Omega}]} \times VCC\ [\mathrm{V}]$$

R_{DUTY} : DUTYADJ connected resistance [kΩ]

Laser Diode Drive Current Mid-value Set Function

The laser diode drive current mid-value can be adjusted by changing the resistance R_{LD} connected between the LDISET and GND pins. The laser diode drive current mid-value base value I_{LDSET}, given by the following equation, is set to the LDIOUT output current when the PDVIN voltage is in balance state (147 to 193mV). Note that the actual LDIOUT current may change due to feedback gain, and laser diode/photo diode variations.

$$I_{LDSET} = I_{LDSET} \times 1000 = \frac{800[\mathrm{V}]}{R_{LD}} \ [\mathrm{A}]$$

R_{LD} : LDISET connected resistance [Ω]

APC Loop Gain Setting

The APC (Auto Power Control) loop gain can be adjusted by changing the external gain set resistance (R_G) connected between the RG1 and RG2 pins. The PDVIN voltage-to-laser drive current open-loop gain is given approximately by the following equation.

$$Gm_{PDVIN} = 9.1 \times 10^{-5} R_G \ [\mathrm{S}]$$

ΔLDIOUT current /ΔPDVIN voltage ratio [S]
R_G : Resistance connected between RG1 and RG2 [Ω]

APC Loop Cutoff Frequency Setting

The APC loop cutoff frequency fc is determined by the external resistance R_G and the capacitance C_G, connected between RG1 and RG2.

$$f_{C1} = \frac{1}{2\pi R_G C_G} \ [\mathrm{Hz}]$$

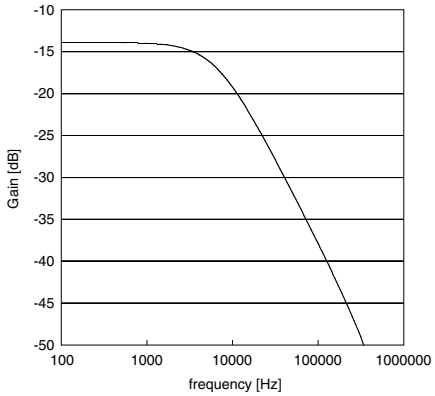
If C_G is connected between RG2 and VCC, the cutoff frequency is given as follows.

$$f_{C2} = \frac{1}{2\sqrt{2}\pi R_G C_G} \ [\mathrm{Hz}]$$

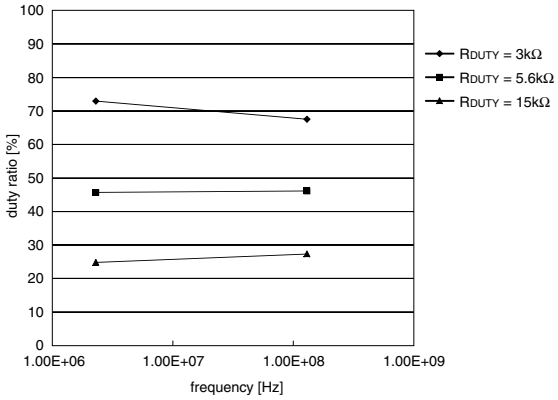
TYPICAL PERFORMANCE CHARACTERISTICS

Conditions: V_{CC} = 2.4V, R_{LD} = 12kΩ, R_{DUTY} = 2.5kΩ, R_G = 2.5kΩ

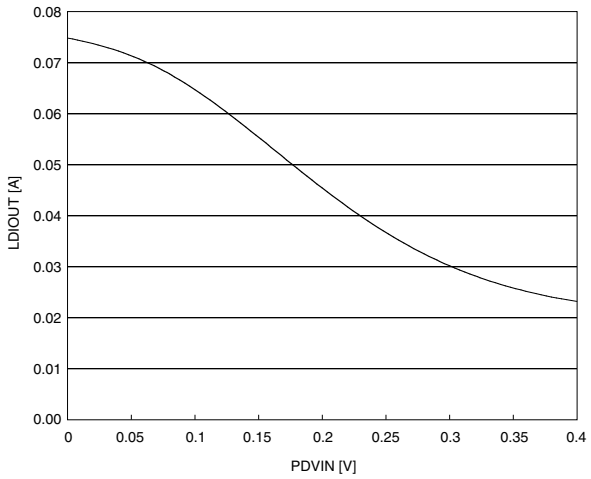
APC loop cut-off frequency (C_G = 0.01μF)

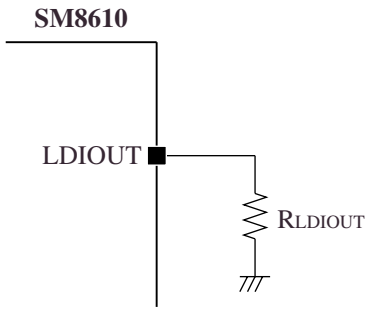


Output duty ratio



Open loop gain and LDIOUT maximum output current (R_{LDIOUT} = 20Ω)





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