SONY

CXA2640ER

3-Channel 2-LD Driver for Optical Disc Drive

Description

The CXA2640ER is a laser driver IC capable of driving two high output lasers (CD/DVD) for writeable optical discs.

Features

- CD maximum drive current: 300mA
  DVD maximum drive current: 250mA
- Capable of generating three-value write waveform through control of one read channel and two write channels
- Rise/Fall times = 1ns
- Read Channel: ×100
- Write Channel: ×840 (CD), ×400 (DVD)
- Read channel has extensive low-noise design
  1.5nA/$\sqrt{Hz}$ (@20MHz, ILD = 35mA, IMOD = 40mAp-p)
- Internal high frequency modulator circuit
  Frequency variable range: 200 to 600MHz
  Maximum modulator current amplitude: 100mAp-p
  Can be set separately for CD and DVD.
- Timing input for generating write waveform can be adapted to both differential input (LVDS/LVPECL) and single end input (3.3V CMOS/TTL).
- Single 5V power supply

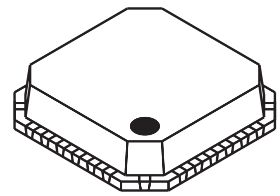
Applications

CD-R, CD-RW, DVD-R, DVD+RW, DVD-RW and DVD-RAM for high-speed writeable optical disc drives

Structure

Bipolar silicon monolithic IC

24 pin VQFN (Plastic)



Absolute Maximum Ratings (Ta = 25°C)

• Supply voltage	Vcc	5.5	V
• Storage temperature	Tstg	–65 to +150	°C

Operating Conditions

• Supply voltage	Vcc	4.5 to 5.5	V
• Operating temperature	Topr	–10 to +75	°C

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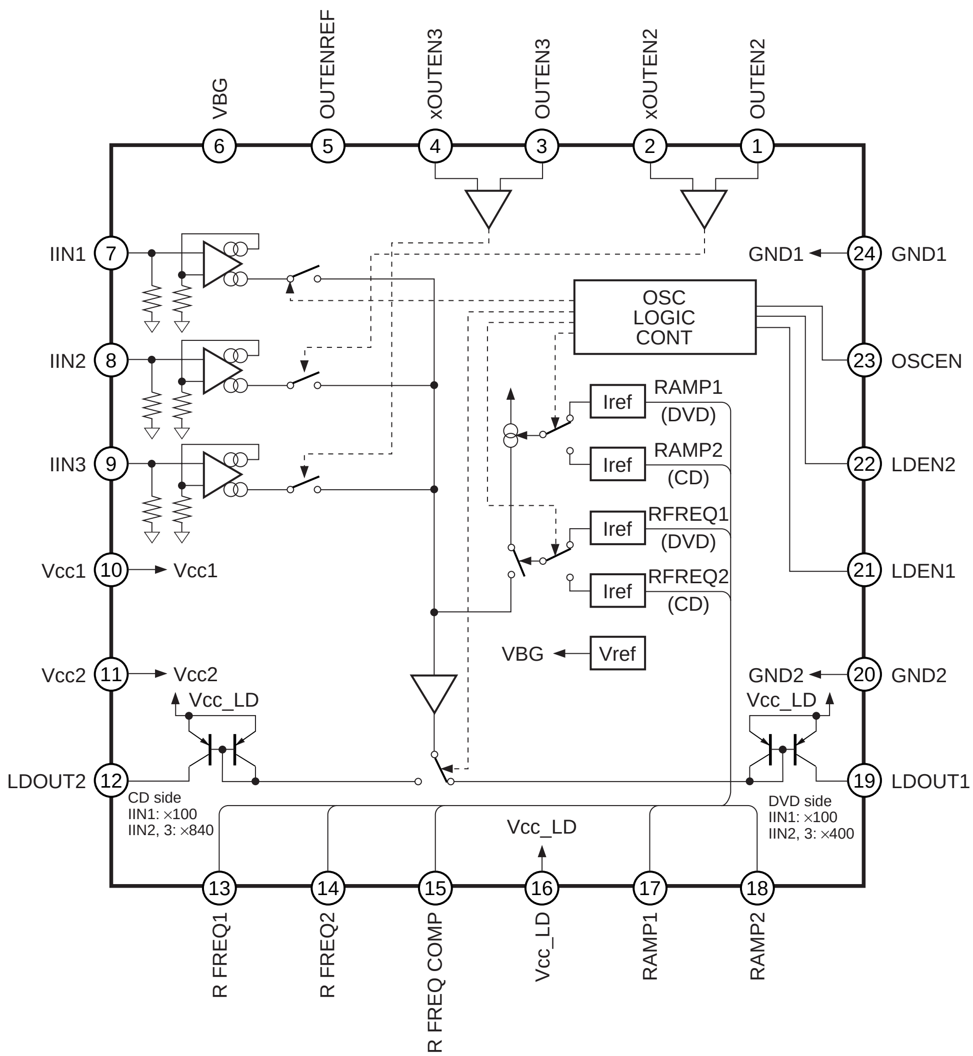
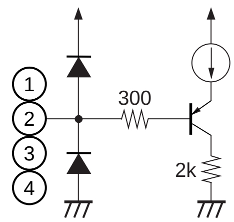
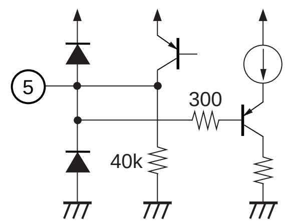
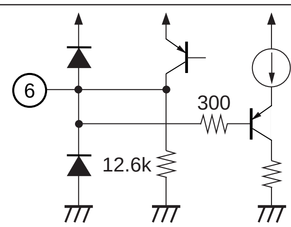
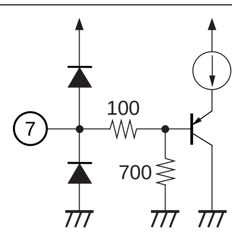
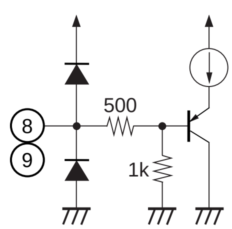
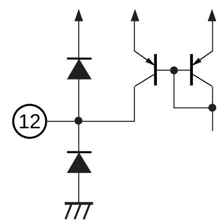
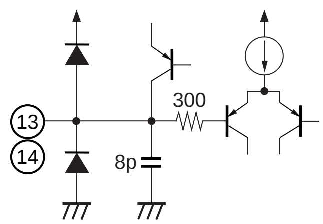
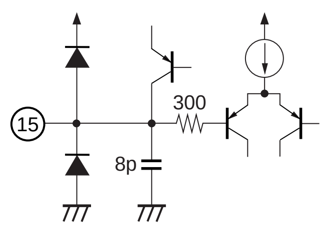
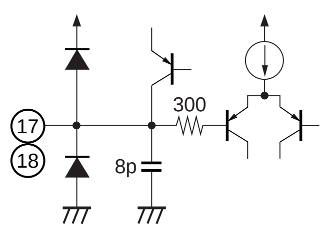
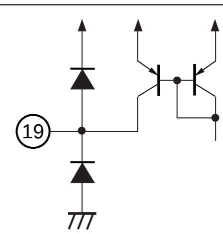
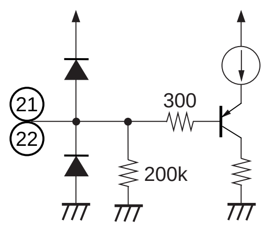
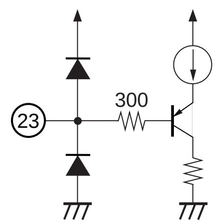
Block Diagram and Pin Configuration



Pin Description

Pin No.	Symbol	I/O	Pin voltage DC	Pin voltage AC	Equivalent circuit	Description
1	OUTEN2	I	—	—		IIN2 set current control signal input. (positive logic)
2	xOUTEN2	I				IIN2 set current control signal input. (negative logic)
3	OUTEN3	I				IIN3 set current control signal input. (positive logic)
4	xOUTEN3	I				IIN3 set current control signal input. (negative logic)
5	OUTENREF	O	1.65V	—		Reference voltage output for current control signal. Connects decoupling capacitance to ground.
6	VBG	O	1.26V	—		Internal reference voltage decoupling.
7	IIN1	I	—	—		Current setting 1. The set current ×100 is output when LDEN1 or LDEN2 = high.
8	IIN2	I	—	—		Current setting pin 2. The set current ×400 is output through LDOUT1 when LDEN1 = high. The set current ×840 is output through LDOUT2 when LDEN2 = high.
9	IIN3	I				Current setting pin 3. The set current ×400 is output through LDOUT1 when LDEN1 = high. The set current ×840 is output through LDOUT2 when LDEN2 = high.
10	Vcc1	I	—	—	—	Supply voltage for control system and modulator system.
11	Vcc2	I	—	—	—	Supply voltage for timing system and current switch.

Pin No.	Symbol	I/O	Pin voltage DC	Pin voltage AC	Equivalent circuit	Description
12	LDOUT2	O	—	—		CD laser drive current output. Enabled when LDEN2 = high.
13	R FREQ1	O	—	—		Modulator frequency setting 1. Enabled when LDEN1 = high. Connects resistance to ground.
14	R FREQ2	O				Modulator frequency setting 2. Enabled when LDEN2 = high. Connects resistance to ground.
15	R FREQ COMP	O	—	—		Modulator frequency variation adjustment. Connects resistance to ground.
16	Vcc_LD	—	—	—	—	Output stage supply voltage.
17	RAMP1	O				Modulator amplitude setting 1. Enabled when LDEN1 = high. Connects resistance to ground.
18	RAMP2	O				Modulator amplitude setting 2. Enabled when LDEN2 = high. Connects resistance to ground.
19	LDOUT1	O				DVD laser drive current output. Enabled when LDEN1 = high.
20	GND2	—	—	—	—	Ground.

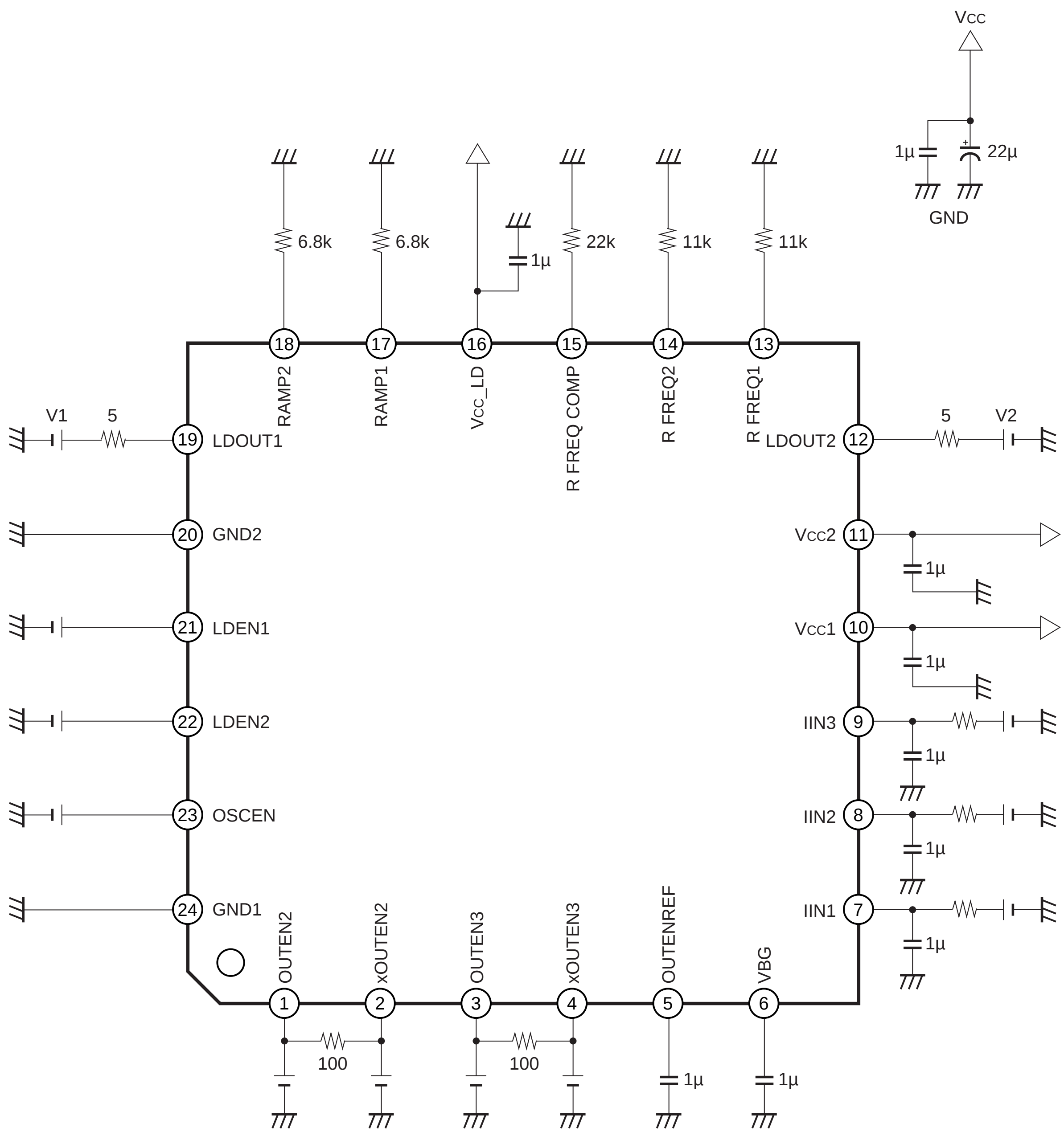
Pin No.	Symbol	I/O	Pin voltage		Equivalent circuit	Description
			DC	AC		
21	LDEN1	I	—	—		DVD output control. (positive logic) When LDEN1 = high, the current set at IIN1 is output through LDOUT1.
22	LDEN2	I	—	—		CD output control. (positive logic) When LDEN2 = high, the current set at IIN1 is output through LDOUT2.
23	OSCEN	I	—	—		Modulator control. (positive logic) Outputs modulator waveform when OSCEN = high.
24	GND1	—	—	—	—	Ground.

Electrical Characteristics (Vcc = 5V, Ta = 25°C)

No.	Measurement item	Symbol	Min.	Typ.	Max.	Unit	Condition
1	Current consumption 1	Icc1	10	16	22	mA	LDEN1, 2 = L
2	Current consumption 2	Icc2	86	123	160	mA	LDEN1 (2) = H, IOUT1 = 60mA, OSCEN = H, AMP = 40mAp-p
3	Current consumption 3	Icc3	128	183	238	mA	LDEN = H, IOUT1 = 60mA, IOUT2 = 120mA (Duty = 25%), IOUT3 = 60mA (Duty = 50%), IOUT = IOUT1 + IOUT2 + IOUT3
4	Current consumption 3-1	Icc3_1	100	144	188	mA	LDEN = H, IOUT1 = 30mA, IOUT2 = 120mA (Duty = 25%), IOUT3 = 60mA (Duty = 50%), IOUT = IOUT1 + IOUT2 + IOUT3
<Logic input block: During single end transfer>							
5	Input voltage high level	VSH	2	—	Vcc	V	
6	Input voltage low level	VSL	GND	—	1.3	V	
<Logic input block: During differential input>							
7	Input voltage high level	VDH	0.8		3	V	
8	Input voltage amplitude	VDL	0.2		3	V	
<LD driver block: DC>							
9	LD drive current 1	IOUTR	100		—	mA	
10	LD drive current 2, 3	IOUTW	250		—	mA	
11	Total LD drive current 1 (DVD)	IOUT1	250	300	—	mA	Vcc = 4.5V, VOP = 3V
12	Total LD drive current 2 (CD)	IOUT2	300	350	—	mA	Vcc = 4.5V, VOP = 2.5V
13	Minimum LD drive current 1 (DVD)	OFFSET1	—	—	4	mA	IIN1 = IIN2 = IIN3 = 0µA, LDEN1 = OUTEN2 = OUTEN3 = H
14	Minimum LD drive current 2 (CD)	OFFSET2	—	—	4	mA	IIN1 = IIN2 = IIN3 = 0µA, LDEN2 = OUTEN2 = OUTEN3 = H
15	Output current noise 1 (DVD)	NOISE1	—	1.5	—	$nA/\sqrt{Hz}$	f = 400MHz, ILD = 35mA, Imod = 40mAp-p (20MHz: NOISE)
16	Output current noise 2 (CD)	NOISE2	—	1.5	—	$nA/\sqrt{Hz}$	f = 400MHz, ILD = 35mA, Imod = 20mAp-p (20MHz: NOISE)
<LD driver block: Pulse driving>							
17	Propagation delay	DELAY	—	3	—	ns	
18	Rise time (Tr)	TR	—	1.5	—	ns	ILD = 50 to 100mA pulse Settling 10% to 90% (resistance load)
19	Fall time (Tf)	TF	—	1.5	—	ns	ILD = 100 to 50mA pulse Settling 10% to 90% (resistance load)

No.	Measurement item	Symbol	Min.	Typ.	Max.	Unit	Condition
<ILD control block>							
20	Input resistance 1 (Pin 7)	ZIINR	0.56	0.8	1.04	kΩ	
21	Input resistance 2 (Pins 8, 9)	ZIINW	1.05	1.5	1.95	kΩ	
22	Input/output gain 1	GAINR	95	105	115	—	
23	Input/output gain 2, 3 (DVD)	GAINW1	360	400	440	—	
24	Input/output gain 2, 3 (CD)	GAINW2	765	840	935	—	
25	ILD control linearity 1 (DVD)	LINEA1	–3.5	—	2.5	%	Based on linearity when ILD = 50 to 150mA Vcc = 4.5V, VI = 1.75V, RL = 5Ω, ILD = 250mA
26	ILD control linearity 2 (CD)	LINEA2	–3.5	—	2.5	%	Based on linearity when ILD = 50 to 150mA Vcc = 4.5V, V2 = 1V, RL = 5Ω, ILD = 300mA
27	Input/output gain relative precision	GACCU	–5	—	5	%	
28	Input/output transmission band	FBAND	7	—	—	MHz	Frequency for input/output gain of –3dB
<High frequency modulator>							
29	Frequency variable range	VARIF	200	—	600	MHz	
30	Amplitude variable range	VARIAMP	—	—	100	mA	fmod = 400MHz
31	Frequency variation	FREQ	–10	—	10	%	fmod = 400MHz
32	Frequency temperature characteristic	TFREQ	—	–116	—	ppm/°C	fmod = 300MHz
33	Amplitude variation	AMP	0	31	42	mAp-p	fmod = 400MHz,
34	Amplitude temperature characteristic	TAMP	—	–319	—	ppm/°C	fmod = 300MHz, RAMP = 10kΩ
35	OSCEN response time (ON)	OSCRES1	—	5	—	ns	
36	OSCEN response time (OFF)	OSCRES2	—	5	—	ns	
<LDEN control>							
37	LDEN response time 1 (ON)	RLDRES1	—	—	700	ns	Time to reach 90% of Read set current (same condition as current consumption 2)
38	LDEN response time 1 (OFF)	RLDRES2	—	—	10	ns	Time to reach 10% of Read set current (same condition as current consumption 2)
39	LDEN response time 2 (ON)	WLDRES1	—	—	700	ns	Time to reach 90% of Write set current (same condition as current consumption 3)
40	LDEN response time 2 (OFF)	WLDRES2	—	—	10	ns	Time to reach 10% of Write set current (same condition as current consumption 3)

Electrical Characteristics Measurement Circuit



Description of Operation

(1) LD Drive Current Value Setting

The current controlled by the current setting pins IIN1, IIN2 and IIN3 is output from the LDOUT1 and LDOUT2 pins. IIN1, IIN 2 and IIN3 can be set respectively by LDEN1, LDEN2, OUTEN and xOUTEN for the output drive current from the LDOUT pin.

(2) Differential Input and Single-end Input

External processing is required for the differential input and single-end input switching.
For the single-end input, if the device is used at the active Low, the OUTENREF pin and the OUTEN pin should be shorted externally; if it is used at the active High, the OUTENREF pin and the xOUTEN pin should be shorted externally. Leave the OUTENREF pin open for the differential input.

(3) Modulator Circuit

The modulator ON/OFF is controlled by the OSCEN pin.
For the DVD side, the modulator frequency is varied by the external resistor connected to the RFREQ1 pin and the modulator amplitude can be varied by the external resistor value connected to the RAMP1 pin.
For the CD side, the modulator frequency is varied by the external resistor connected to the RFREQ2 pin and the modulator amplitude can be varied by the external resistor value connected to the RAMP2 pin.

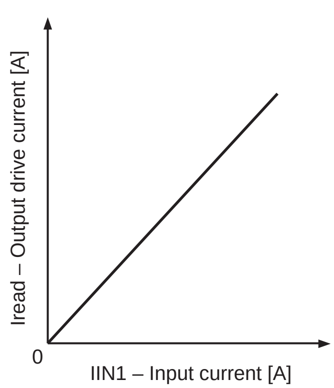
(4) RFREQ COMP Pin

The current depending on the internal resistor is generated using the RFREQ COMP pin external resistor to suppress the dispersion of the modulator frequency depending on the internal resistor.
The RFREQ COMP pin external resistor is recommended to be fixed to 22kΩ.

(5) Modulator Level Adjustment

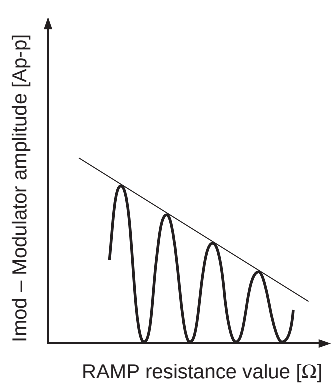
The modulator level adjustment can be performed by varying the IIN1 input current value.

Modulator OFF



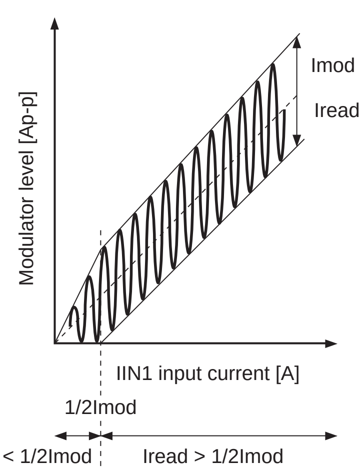
$\text{Iread} = \text{IIN1} \times 104$

Modulator amplitude



$$\text{Imod} \approx \frac{\text{RAMP pin voltage (1.26V)}}{\text{RAMP external resistance value}} \times 200$$

Modulator level adjustment



Description of Functions

1. Logic table

Output control

LDEN1	LDEN2	xOUTEN2	xOUTEN3	OSCEN	LDOUT1 (DVD)	LDOUT2 (CD)
L	L	X	X	X	OFF	OFF
H	L	H	H	L	100 × IIN1	OFF
H	L	L	H	L	100 × IIN1 + 400 × IIN2	OFF
H	L	H	L	L	100 × IIN1 + 400 × IIN3	OFF
H	L	L	L	L	100 × IIN1 + 400 × IIN2 + 400 × IIN3	OFF
L	H	H	H	L	OFF	100 × IIN1
L	H	L	H	L	OFF	100 × IIN1 + 840 × IIN2
L	H	H	L	L	OFF	100 × IIN1 + 840 × IIN3
L	H	L	L	L	OFF	100 × IIN1 + 840 × IIN2 + 800 × IIN3
H	H	X	X	X	OFF (inhibit)	OFF (inhibit)

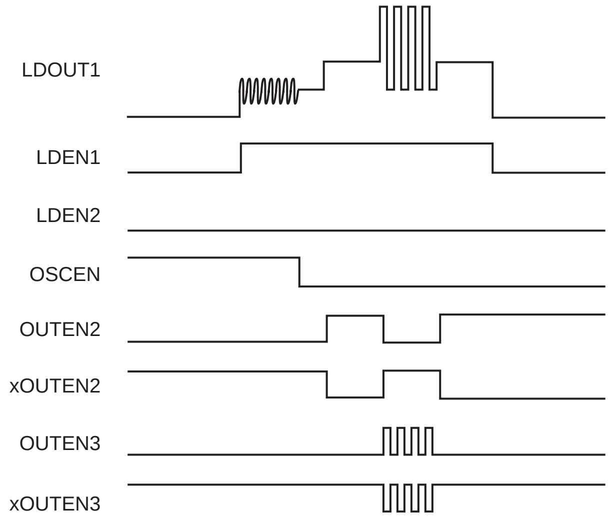
Module control

LDEN1	LDEN2	xOUTEN2	xOUTEN3	OSCEN	LDOUT1	LDOUT2
L	L	X	X	X	OFF	OFF
H	L	X	X	L	MODOFF	OFF
H	L	X	X	H	MODON (Rfreq1, Ramp1)	OFF
L	H	X	X	L	OFF	MODOFF
L	H	X	X	H	OFF	MODON (Rfreq2, Ramp2)
H	H	X	X	X	OFF (inhibit)	OFF (inhibit)

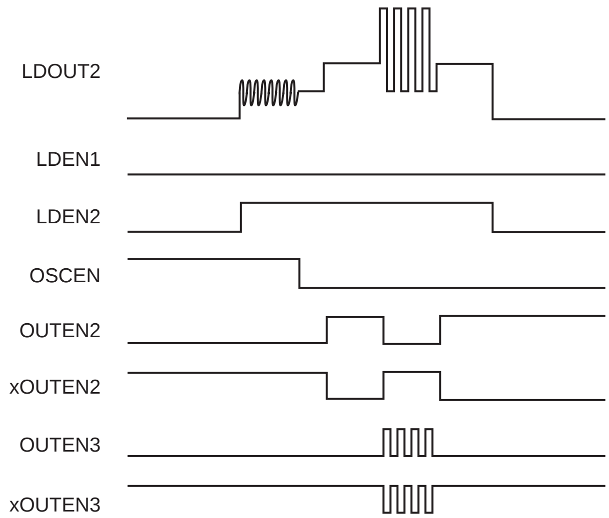
Note: Module control does not depend on a data timing signals.

2. Timing Chart

(DVD side)



(CD side)



Notes on Operation

- Arrange the external resistors connected to the IIN1, IIN2 and IIN3 pins near the IC package to reduce the affects from other signal lines.
- Wiring between the output LDOUT pin and the laser diode, and wiring between the Vcc_LD pin and external decoupling capacitors should be the shortest. Making the distance for wiring long increases output waveform overshoots and undershoots caused by the affect of wiring inductance.
- The Vcc_LD pin's external decoupling capacity ground can be grounded to the GND grounding the load from the LDOUT pin. This reverses the phase of the drive waveform at the LDOUT and Vcc_LD and moves in the direction that suppresses overshoots and undershoots.
- Temperature guarantee
  Thermal resistance (θj-a) when the CXA2640ER is mounted on PWB varies according to the set (PWB) and because it is difficult to predict along with the tendency for higher power for power consumption (Po), the following points should be considered when using.
  Use in a range that does not exceed a junction temperature of 150°C. Also, power consumption (P_O) should be below allowable power dissipation (P_D). Use with the thermal resistance (θj-a) of the PWB mounting lowered so that it can be operated normally at a maximum operating temperature of 75°C. To lower θj-a, radiating measures on the set, such as widening the GND region with the set PWB are needed. Also, the die-pad on the CXA2640ER 24-pin VQFN package is exposed on the backside, so thermal transmission from the IC backside to the PWB is excellent. For that reason, it is possible to release heat from the PBC to the set chassis thereby lowering the thermal resistance of the PWB mount.
  Find the thermal resistance (θj-a) when mounted on PWB and power consumption (P_O) using the following method.

  Po = (Icc × Vcc) – (Iop × Vop)
  - Icc: IC current consumption when operating (Including Iop)
  - Iop: Output drive current flowed from the LDOUT pin to the Laser Diode
  - Vop: Operating voltage of the laser diode

It is also possible for Po when a modulator is ON (Imod = 40mAp-p), although the precision will decrease.
On the DVD side: Po = (50mA + IIN1 × 2.6 + (IIN2 + IIN3) × 10) × V_{CC} + (Iop × (Vcc – Vop))
On the CD side: Po = (50mA + IIN1 × 2.6 + (IIN2 + IIN3) × 21) × V_{CC} + (Iop × (Vcc – Vop))

Thermal resistance (θj-a) when mounted on PWB

- The thermal resistance (θc-a) is obtained by measuring the Package surface temperature using a thermo couple or a radiation thermometer.
  In order to improve the precision of measurement, it is desired to calculate by the following formula.
  ΔPackage surface temperature when Iop is variable/ΔPo
  Assume the thermal resistance (θj-c) to be approximately 2°C/W.

- Diode thermal coefficient –2.27mV/°C and the positive protection diode thermal characteristics are used to find this.
  The V2 voltage found in (2) below cancels the voltage decrease caused by the wiring resistance between the positive protection diode connection Vcc and the Vcc pins as reference and is measured to find the precise temperature characteristics of the positive protection diode.

(1) V1 to OSCEN pin voltage to Vcc pin voltage, Icc1 to current consumption when 0V is applied to the IIN1, IIN2 and IIN3 pins.
(2) V2 to OSCEN pin voltage to Vcc pin voltage immediately after applying the arbitrary voltage to the IINx pin.
(3) V3 to OSCEN pin voltage to Vcc pin voltage, Icc3 to consumption current when applying the arbitrary voltage to the IINx pin and heat reaches equilibrium.

ΔTj using the voltage drop (V1 to V2) between the positive protection diode connection Vcc and the Vcc pins that are the reference, as described above are:

$$\Delta Tj = ((V3 + (V1 - V2)) - V1)/-2.27\text{mV}/°\text{C}$$

Thermal resistance (θj-a) is:

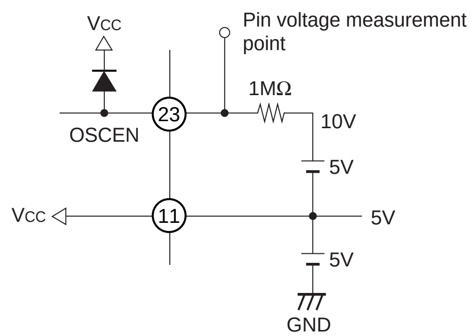
$$\theta j\text{-}a = \Delta Tj/((Icc3 - Icc1) \times Vcc - Iop \times Vop)$$

- Allowable power dissipation (P_D) ≥ P_O [W]

$$P_D = (150°\text{C} - \text{Ambient temperature})/\theta j\text{-}a$$

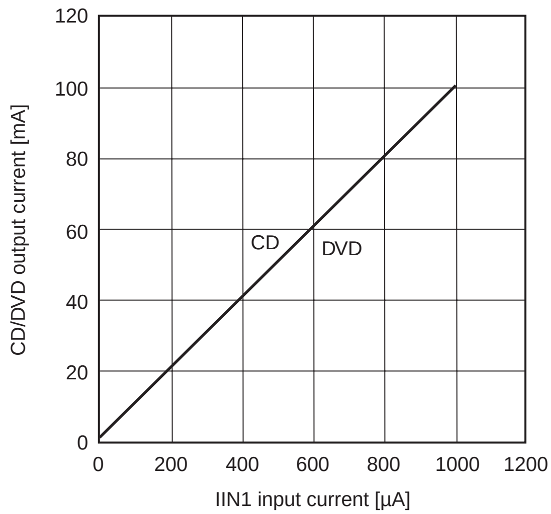
- Maximum operating temperature

$$(150°\text{C} - \Delta Tj) \geq 75°\text{C}$$

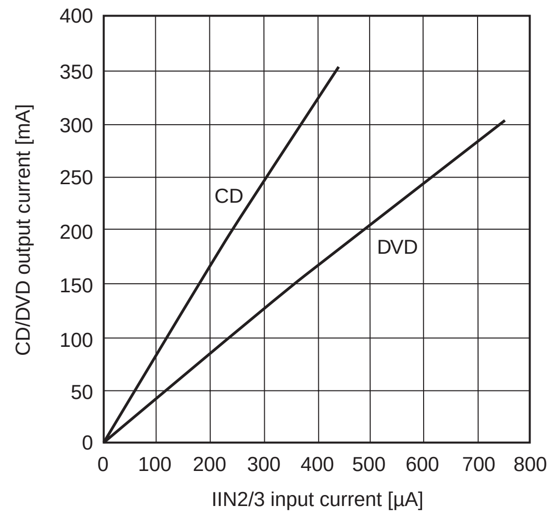


Example of Representative Characteristics

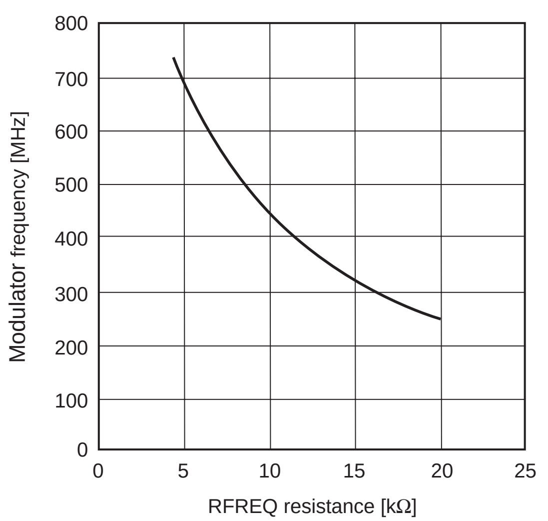
IIN1 input current vs.
CD/DVD output current characteristics
Vcc = 5V, resistance load



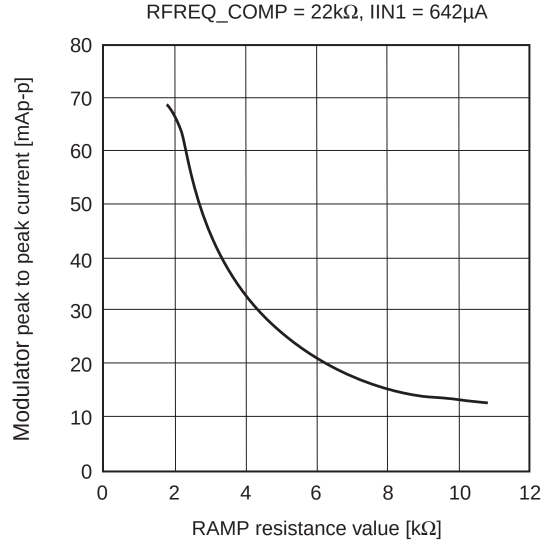
IIN2/3 input current vs.
CD/DVD output current characteristics
Vcc = 5V, resistance load



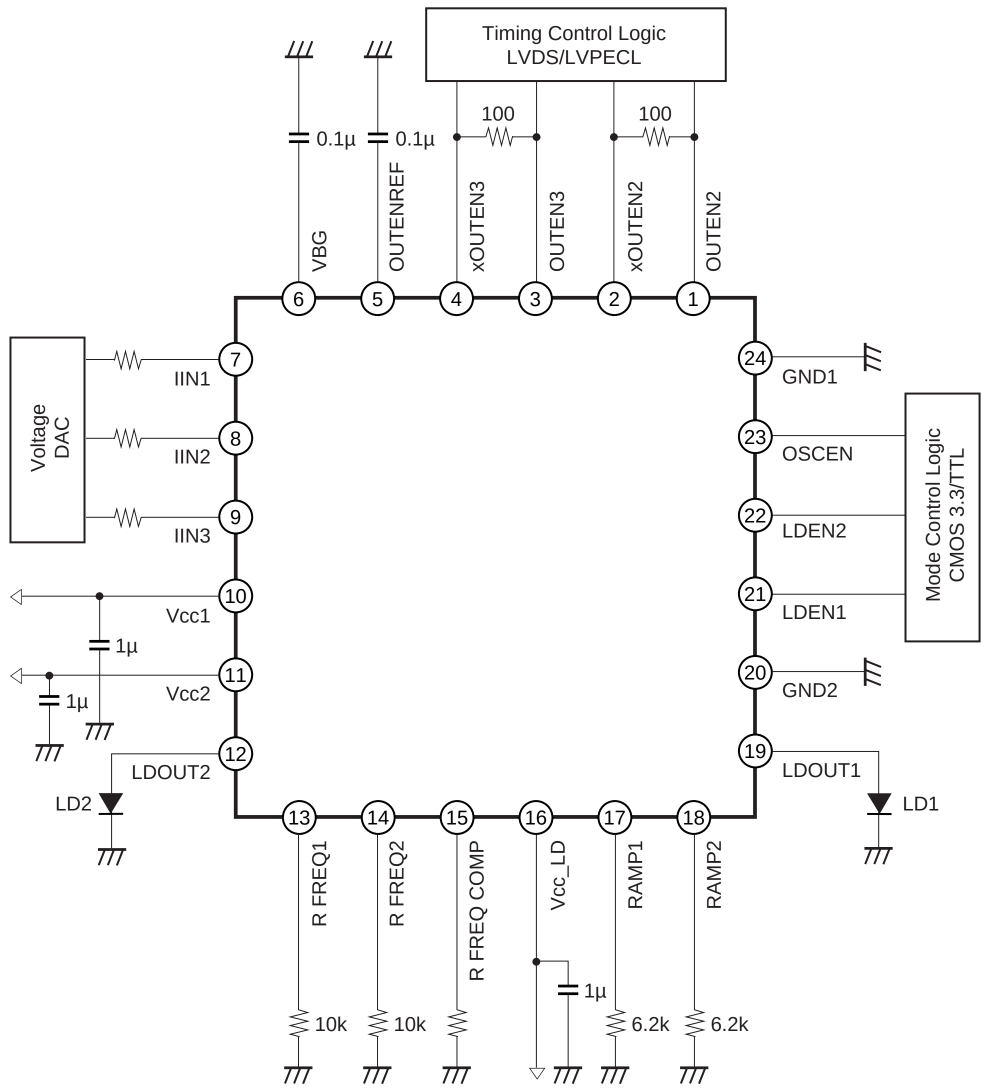
Modulator frequency control characteristics
RAMP = 3.3kΩ (approximately 40mAp-p)
RFREQ_COMP = 22kΩ, IIN1 = 642µA



RAMP resistance value vs.
modulator waveform peak current characteristics
RFREQ = 12kΩ (approximately 390MHz)
RFREQ_COMP = 22kΩ, IIN1 = 642µA

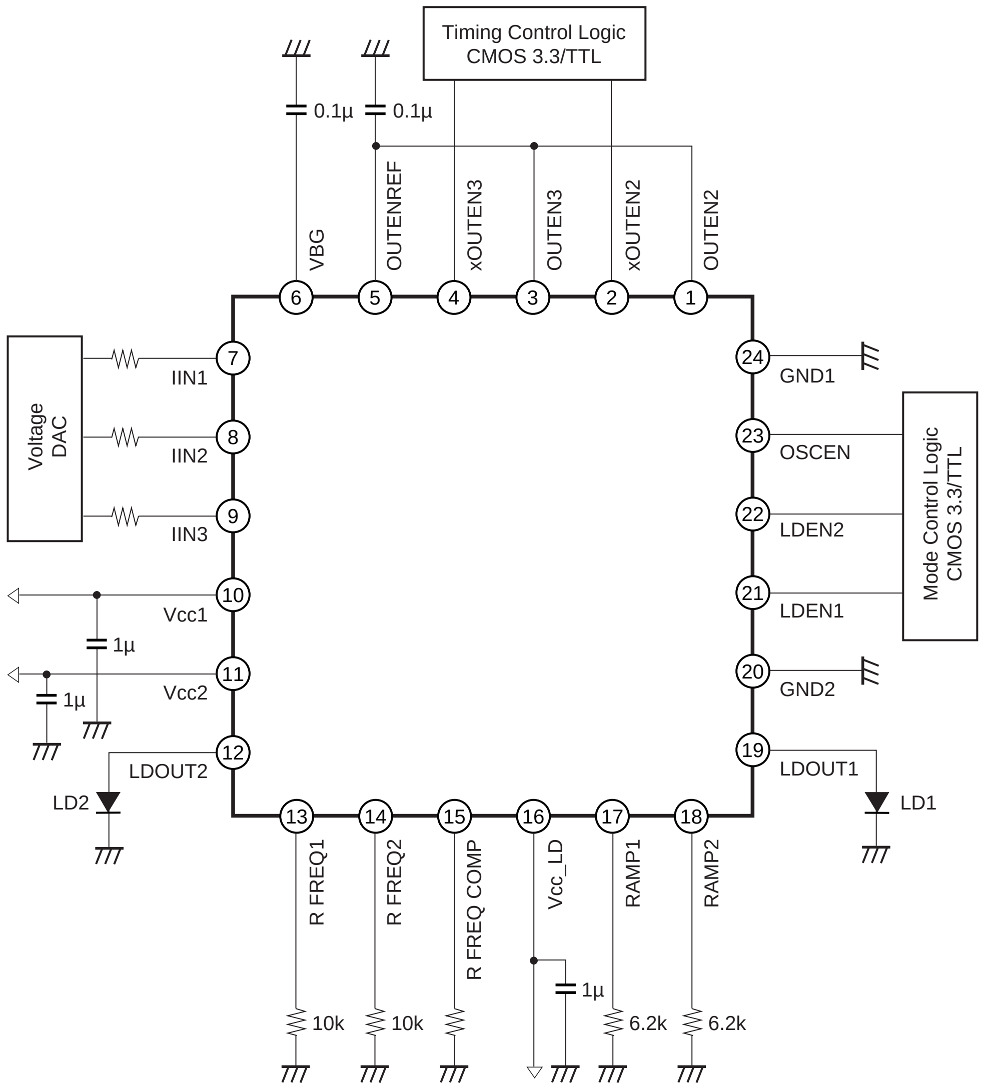


Application circuit 1



Application circuits shown are typical examples illustrating the operation of the devices. Sony cannot assume responsibility for any problems arising out of the use of these circuits or for any infringement of third party patent and other right due to same.

Application circuit 2



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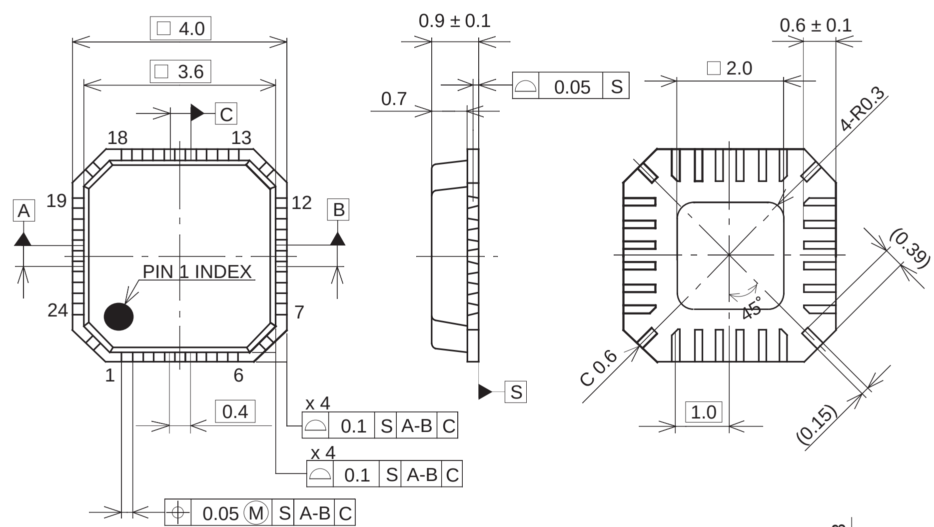
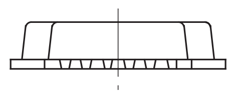
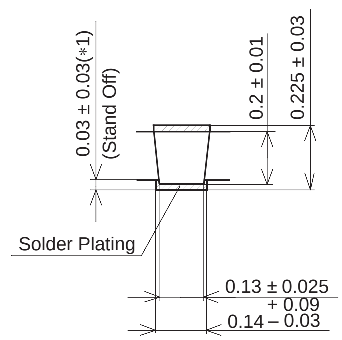
Package Outline Unit: mm

24PIN VQFN(PLASTIC)







NOTE: 1) The dimensions of the terminal section apply to the ranges of 0.1mm and 0.25mm from the end of a terminal.
2) The dimension of (*1) is apply to DiePad and the lead.

TERMINAL SECTION

PACKAGE STRUCTURE

SONY CODE	VQFN-24P-04
EIAJ CODE	——————
JEDEC CODE	——————

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	COPPER ALLOY
PACKAGE MASS	0.04g

LEAD PLATING SPECIFICATIONS

ITEM	SPEC.
LEAD MATERIAL	COPPER ALLOY
SOLDER COMPOSITION	Sn-Bi Bi:1-4wt%
PLATING THICKNESS	5-18µm