OPA2048CA

Self-Scanning Line Sensor

GENERAL DESCRIPTION

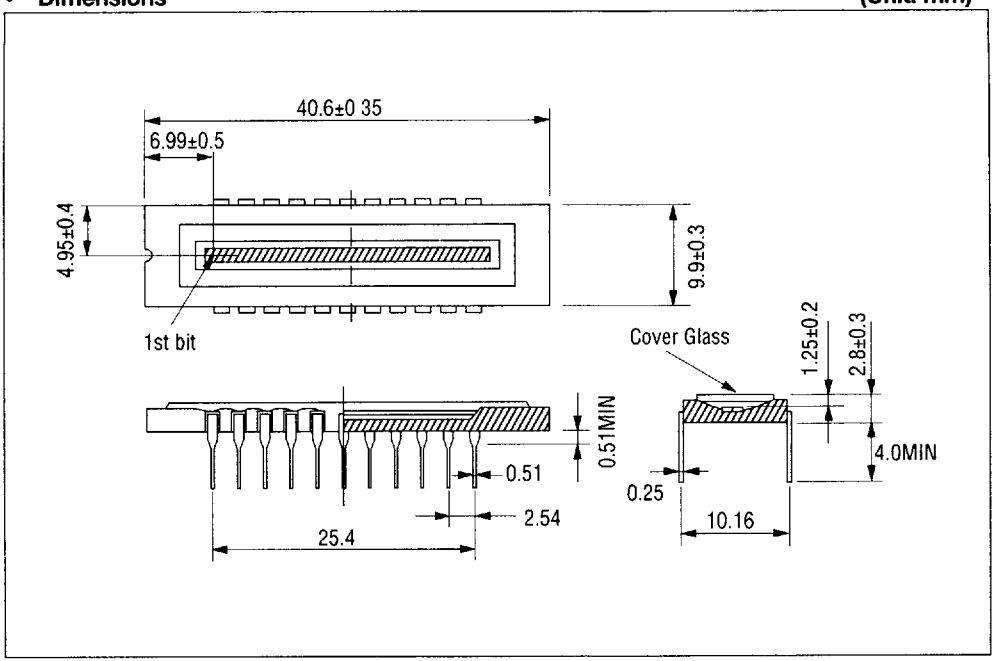
The OPA2048CA is a 2,048-bit, 1-dimensional diode array comprised of PN junction photodetector diodes and CCDs (charge coupled devices). By using a 2-phase clock pulse, transfer pulse, and reset pulse, the OPA2048CA can measure incident light.

FEATURES

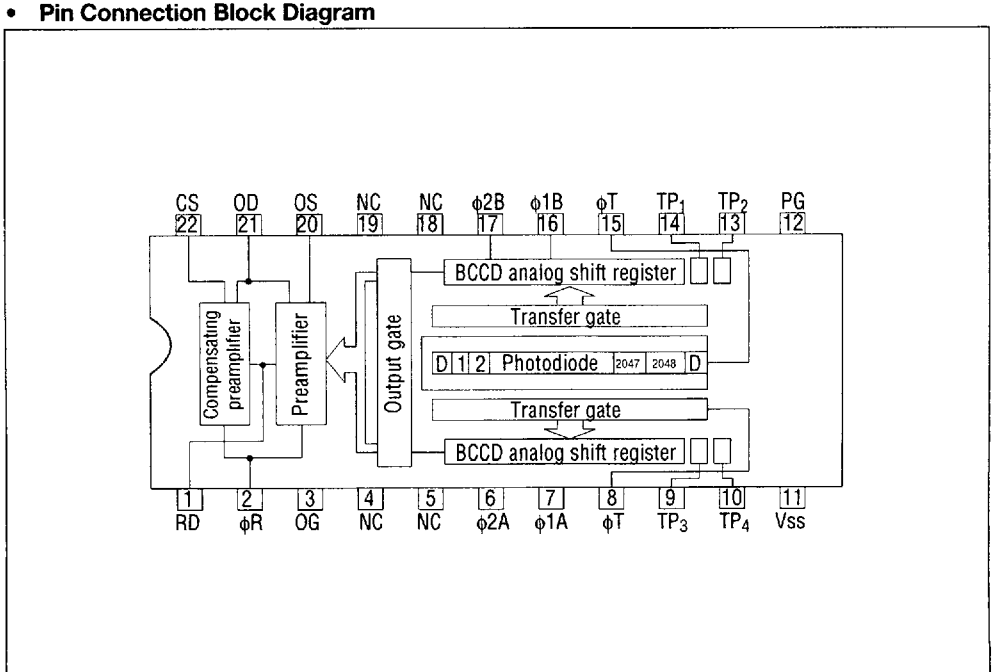
- Dynamic range: TYP 500
- CCD for high sensitivity
- CCD transmission efficiency greater than 99.995%
- Photo detector configured of PN junction photodetector diodes for good blue sensitivity and outstanding output characteristics
- Photodiodes highly integrated with 13 μm pitch for high resolution
- High-speed scanning
- Low-voltage operation
- Internal output amplifier and compensating amplifier

PIN CONFIGURATION

- **Dimensions** (Unit: mm)



- **Pin Connection Block Diagram**



Symbol	Name
RD	Reset transistor drain
ϕR	Reset transistor gate clock
OG	Output gate
ϕ1A	CCD register clock
ϕ1B	CCD register clock
ϕ2A	CCD register clock
ϕ2B	CCD register clock
ϕT	Phototransfer gate clock
V_{SS}	Substrate bias
TP_1	Test pin (electrical input gate)
TP_2	Test pin (electrical input diode)
TP_3	Test pin (electrical input gate)
TP_4	Test pin (electrical input diode)
PG	Photogate
OD	Output transistor drain
OS	Output transistor source (video output)
CS	Compensating transistor source (noise output)

APPLICATIONS

- Facsimiles
- OCRs
- Industrial control
- Monitoring devices
- Object recognition
- Measurement devices

ABSOLUTE MAXIMUM RATINGS

(Ambient Temperature Ta=25°C)

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T_{stg}	−40	+125	°C
Operating Temperature	T_{opr}	−20	+85	°C
Clock Voltage	$V\phi$	−0.3	+18	V
Applied Voltage	V_{DD}	−0.3	+18	V

ELECTRICAL CHARACTERISTICS

(Ambient Temperature Ta=25°C)

Parameter			Symbol	Guaranteed Value Min.	Typ.	Max.	Unit
Reset Drain Voltage			V_{DD} V_{RD}	11.4	12	12.6	V
Output Transistor Drain Voltage			V_{DD} V_{OD}	11.4	12	12.6	V
Output Gate Voltage			V_{OG}	4.75	5	5.25	V
Photo Gate Voltage			V_{PG}	4 75	5	5.25	V
Substrate Bias			V_{SS}	−1.5	−2	−2.5	V
Electrical Input Diode Voltage ($TP_{2,4}$)			V_{IS}	11.4	12	12.6	V
Electrical Input Gate Voltage ($TP_{1,3}$)			V_{IG}	−0.1	0	0 2	V
Spectral Sensitivity Range			λ_R	400	—	1000	nm
Reset Clock Pulse Frequency (Video Frequency)			ϕf_R(fv)	0.25	1	*1 3	MHz
Clock Pulse Voltage	CCD register	"H"	$V\phi_{1\,2}^{AB}H$	7	V_{DD}	V_{DD}	V
		"L"	$V\phi_{1\,2}^{AB}L$	−0 3	0.4	0 8	V
	Photo-transfer	"H"	$V\phi_T H$	7	V_{DD}	V_{DD}	V
		"L"	$V\phi_T L$	−0.3	0.4	0.8	V
	Reset	"H"	$V\phi_R H$	7	V_{DD}	V_{DD}	V
		"L"	$V\phi_R L$	−0.3	0.4	0.8	V
Clock Input Capacitance	CCD register		$C\phi_{1\,2}^{AB}$	300	400	520	pF
	Photo-transfer		$C\phi_T$	10	25	50	pF
	Reset		$C\phi_R$	2	4	8	pF
Load Resistance			R_L	0.9	1	1 5	kΩ
Output DC Level			V_{dc}	—	4.0	8.5	V
Power Consumption *2			P_D	50	70	100	mW

*1 When load capacitance C_L=31 pF

*2 When load resistance R_L=1 kΩ

POTOELECTRIC CHARACTERISTICS

(Ambient Temperature Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Saturation Exposure	Esat	—	0 23	—	Lx • sec	*1
Saturation Output Voltage	Vsat	180	250	—	mV	*2
Sensitivity	R_W	—	1 1	—	V/Lx • sec	*1
Output Nonuniformity	U_F	—	—	±10	%	*3
Dark Output Voltage	Vd	—	0 5	3.1	mV	*4
Dynamic Range	DR	—	500	—	—	*2, *4

Test Conditions { $V_{RD}=V_{OD}=V\phi=12$ V; $V_{PC}=V_{OG}=5$ V; $V_{SS}=-2$ V; TP2.4=12 V; TP1.3=0 V; $R_L=1$ kΩ; fV=1 MHz; TINT=10 ms

Conditions

*1 2856°K tungsten lamp

*2 Daylight fluorescent lamp

*3 Daylight fluorescent lamp 50% saturation exposure

*4 Dark state

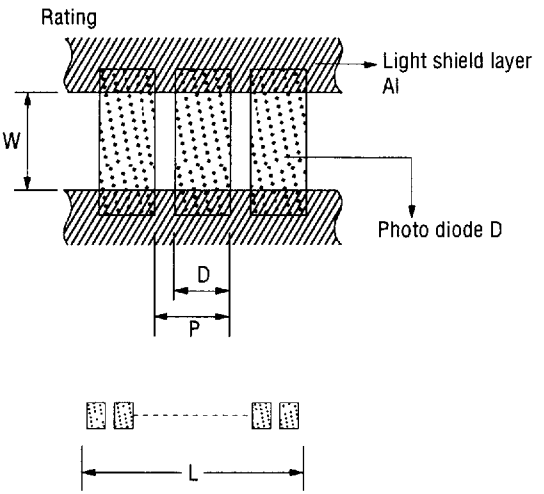
PIXEL CONFIGURATION

(Ambient Temperature Ta=25°C)

Parameter	Symbol	Central Value	Accuracy	Unit
Arrangement	—	Straight line	—	—
Number of Pixels	—	2048	—	sec
Pixel Pitch	P	13	±2 0	μm
Photo Diode Width	D	8	±2.0	μm
Aperture Width	W	13	±2 5	μm
Sensor Length	L	26624	±5 0	μm

* See "Output Timing" for information concerning dummy pixels.

PHOTO DIODE LAYOUT



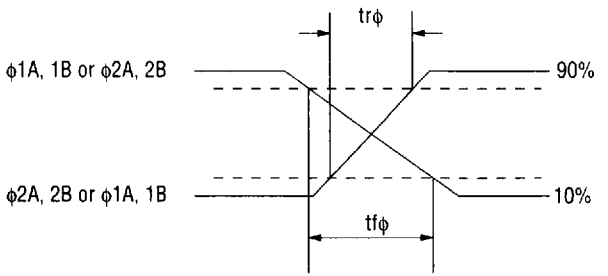
CLOCK INPUT TIMING CHARACTERISTICS

(Ambient Temperature Ta=25°C)

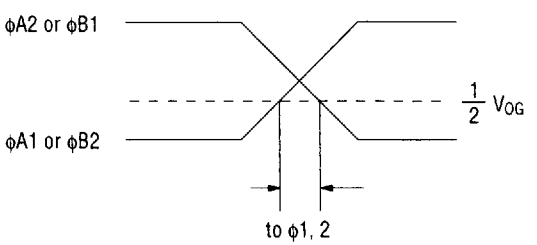
	Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Register	Rise time	$t_{r\phi}$	—	30	100	ns	*1
	Fall time	$t_{f\phi}$	—	20	100	ns	
	Overlap time	$t_{O\phi}1, 2$	0	20	100	ns	*2
	Blank time	$t_{B\phi}1, 2$	—	20	100	ns	*3
Phototransfer	Rise time	$t_{r\phi}T$	—	30	100	ns	*4
	Fall time	$t_{f\phi}T$	—	20	100	ns	
	Transfer time duration	$t_{W\phi}r$	5	10	15	μs	
	Setup time	$t_{S\phi}T$	0	1	10	μs	
	Hold time	$t_{H\phi}T$	0	1	10	μs	
Reset	Rise time	$t_{r\phi}R$	—	—	100	ns	*5
	Fall time	$t_{f\phi}R$	—	—	100	ns	
	Duration	$t_{W\phi}R$	80	—	2000	ns	
	Setup time	$t_{S\phi}R$	170	—	2000	ns	
	Hold time	$t_{H\phi}R$	0	—	2000	ns	

OPA2048CA INPUT TIMING DIAGRAMS

*1

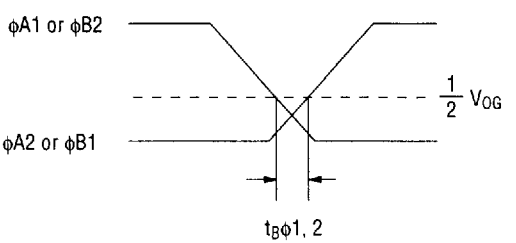


*2



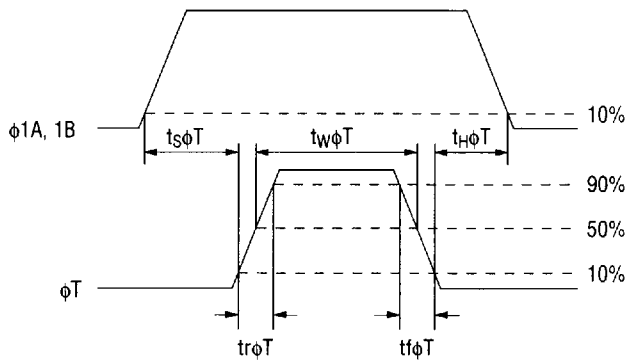
Limited to periods during ϕA1 rise and ϕA2 fall, and ϕB2 rise and ϕB1 fall

*3

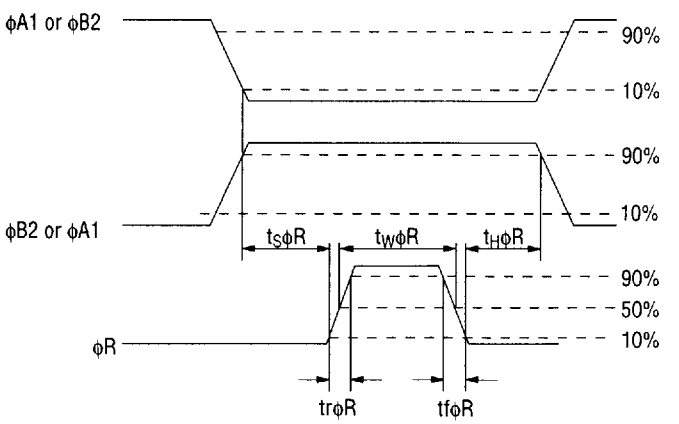


Limited to periods during ϕA2 rise and ϕA1 fall, and ϕB1 rise and ϕB2 fall

*4


ϕ1A, 1B
tSϕT
tWϕT
tHϕT
10%
90%
50%
10%
ϕT
trϕT
tfϕT

*5


ϕA1 or ϕB2
90%
10%
90%
10%
ϕB2 or ϕA1
tSϕR
tWϕR
tHϕR
90%
50%
10%
ϕR
trϕR
tfϕR

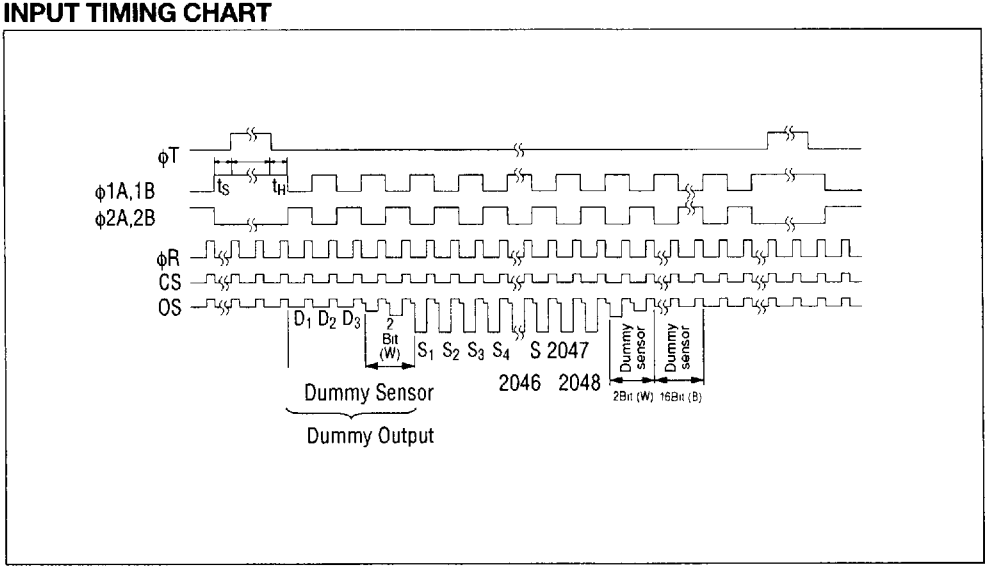
VIDEO OUTPUT TIMING CHARACTERISTICS

(Ambient Temperature Ta=25°C)

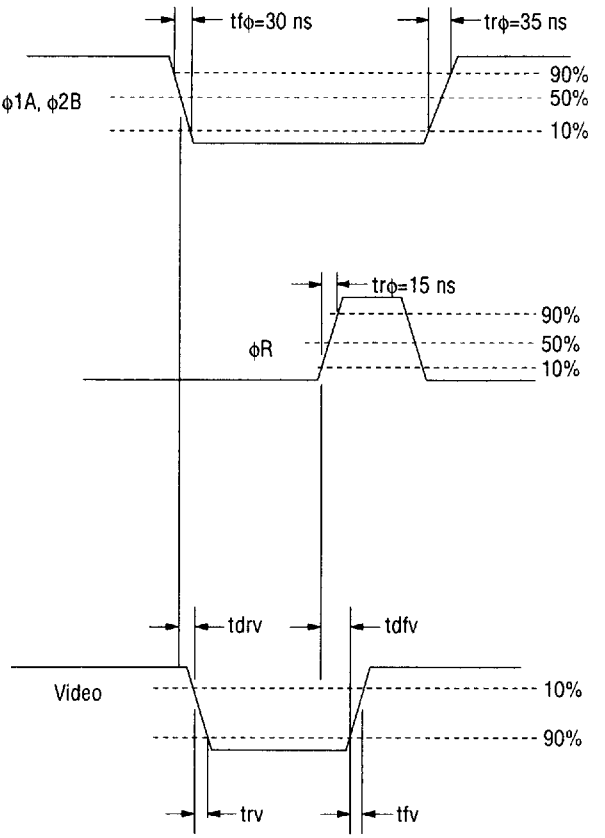
Parameter	Symbol	Guaranteed Values			Unit	Note
		Min.	Typ.	Max.		
Video Rise Delay Time	tdrv	—	55	—	ns	—
Video Rise Time	trv	—	55	—	ns	—
Video Fall Delay Time	tdfv	—	15	—	ns	—
Video Fall Time	tfv	—	30	—	ns	—

Conditions: $V_{DD}=V_{RD}=V\phi=12$ V, $V_{DG}=V_{PG}=5$ V, $V_{SS}=-2$ V, $R_L=1$ kΩ, $C_L=31$ pF, Ta=25°C, $t_f\phi=30$ ns, $t_r\phi=35$ ns, $t_r\phi R=15$ ns

INPUT TIMING CHART

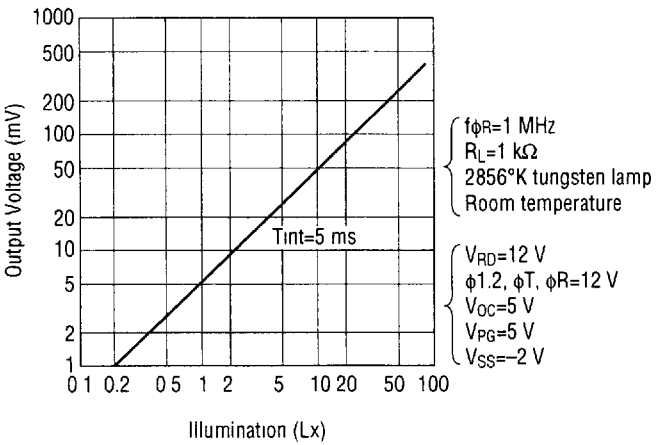


OUTPUT TIMING DIAGRAMS

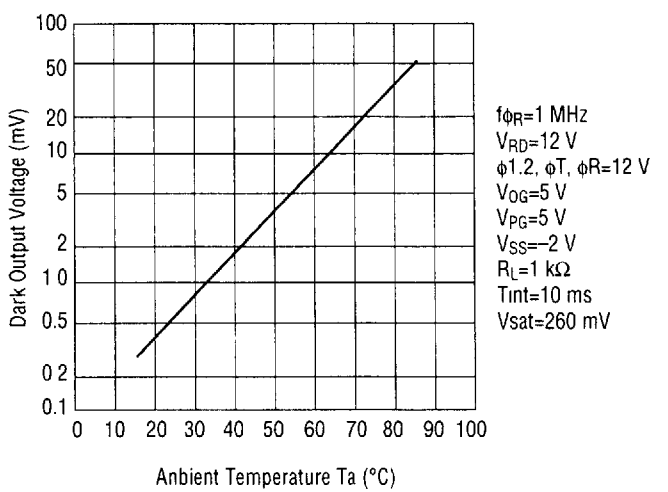


TYPICAL CHARACTERISTICS

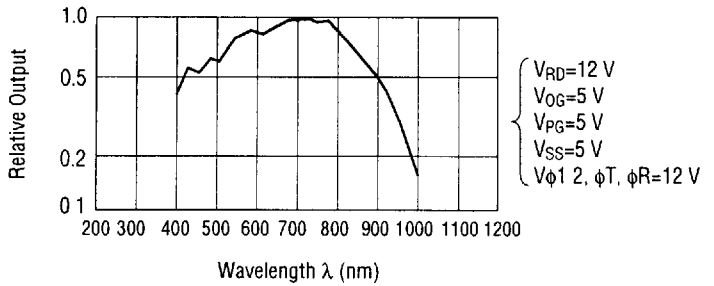
- **Photoelectric Conversion Characteristics**



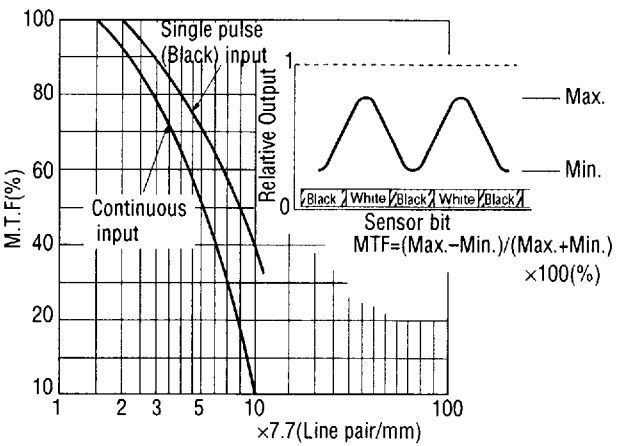
- **Dark Output Voltage vs. Temperature Characteristics**



- **Spectral Sensitivity Characteristics**



- **M.T.F. Characteristics (White Fluorescent Light)**



DRIVE CIRCUIT