OKI electronic components

OPA2048CA

Self-Scanning Line Sensor

GENERAL DESCRIPTION

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

FEATURES

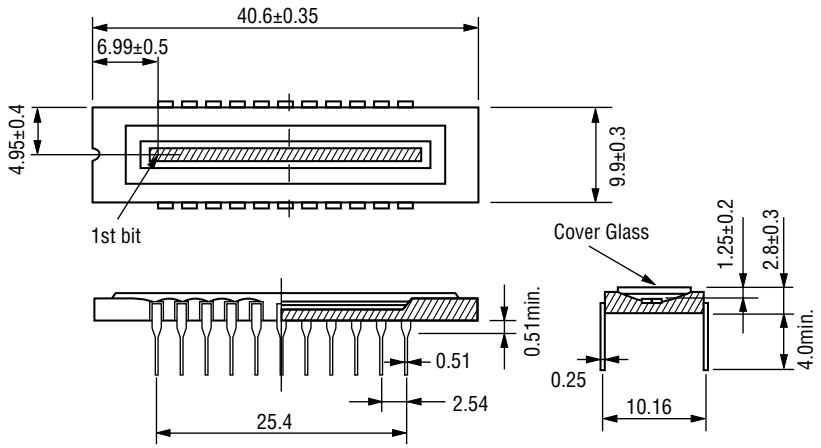
- Dynamic range: TYP 500
- CCD for high sensitivity
- CCD transfer efficiency greater than 99.995%
- Photodetector configured of PN junction photodetector diodes for good blue sensitivity and good output uniformity.
- Photodiodes highly integrated with 13 µm pitch for high resolution
- High-speed scanning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

APPLICATIONS

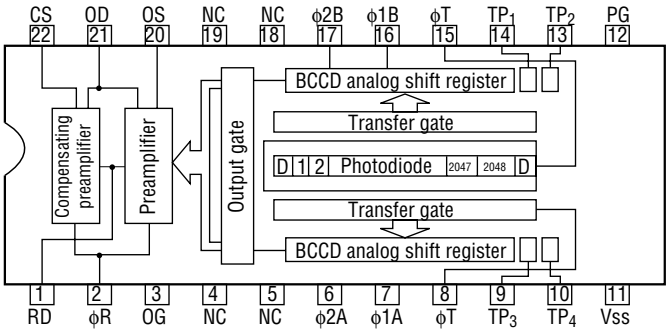
- Facsimiles
- OCRs
- Industrial control
- Monitoring devices
- Object recognition
- Measurement devices

PIN CONFIGURATION

- **Dimensions** **(Unit: mm)**



- **Pin Connection Block Diagram**



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

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Test Condition	Min.	Max.	Unit
Storage Temperature	T_{stg}	—	–40	+125	°C
Operating Temperature	T_{opr}	—	–20	+85	°C
Clock Voltage	$V\phi$	Ta=25°C	–0.3	+18	V
Applied Voltage	V_{DD}		–0.3	+18	V

ELECTRICAL AND OPTICAL 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_{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"	$V\phi^{AB}_{1, 2}H$		7	V_{DD}	V_{DD}	V
		"L"	$V\phi^{AB}_{1, 2}L$		–0.3	0.4	0.8	V
	Phototransfer	"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		$C\phi^{AB}_{1, 2}$		300	400	520	pF
	Phototransfer		$C\phi_T$		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

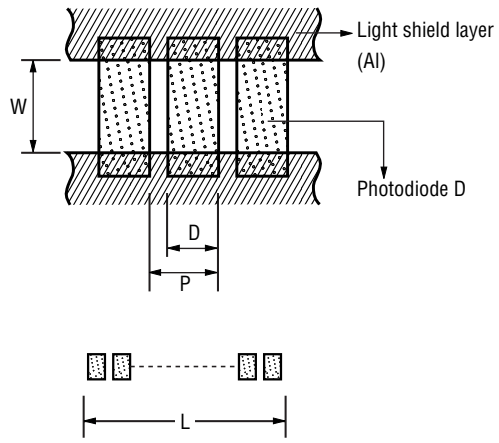
PIXEL CONFIGURATION

(Ambient Temperature Ta=25°C)

Parameter	Symbol	Central Value	Accuracy	Unit
Arrangement	—	Straight line	—	—
Number of Pixels	—	2048	—	—
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.

Pixcel Configuration Diagram



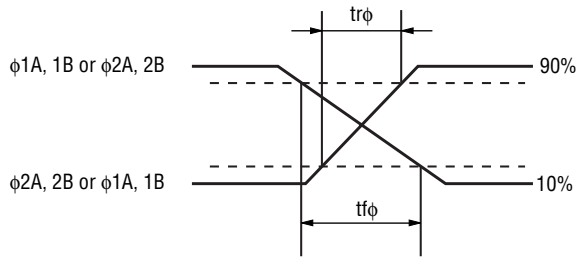
CLOCK INPUT TIMING CHARACTERISTICS

(Ambient Temperature Ta=25°C)

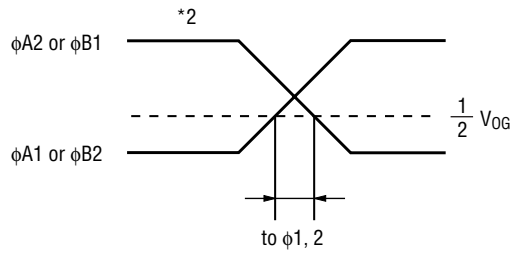
	Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Register	Rise time	$t_{r\phi}$	—	30	100	ns	*1
	Fall time	$t_{f\phi}$	—	20	100	ns	
	Overlap time	$t_{O\phi}1, 2$	0	20	100	ns	*2
	Blank time	$t_{B\phi}1, 2$	—	20	100	ns	*3
Phototransfer	Rise time	$t_{r\phi}T$	—	30	100	ns	*4
	Fall time	$t_{f\phi}T$	—	20	100	ns	
	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

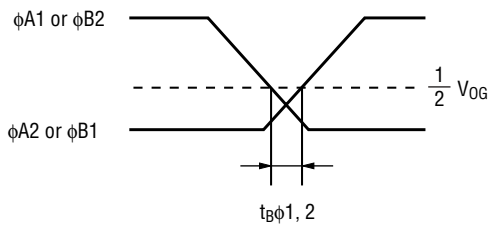


*2



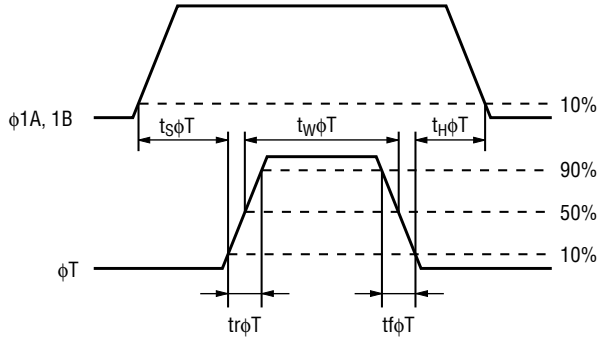
Limited to periods during ϕA1 rise and ϕA2 fall, and ϕB2 rise and ϕB1 fall.

*3

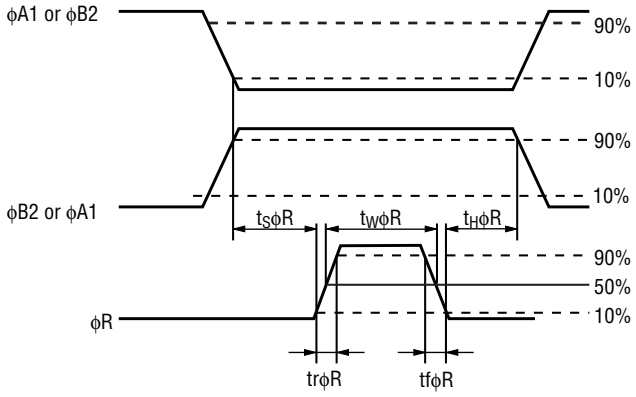


Limited to periods during ϕA2 rise and ϕA1 fall, and ϕB1 rise and ϕB2 fall.

*4



*5



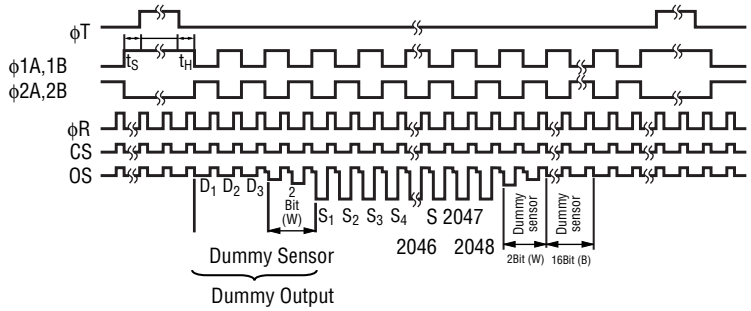
VIDEO OUTPUT TIMING CHARACTERISTICS

(Ambient Temperature Ta=25°C)

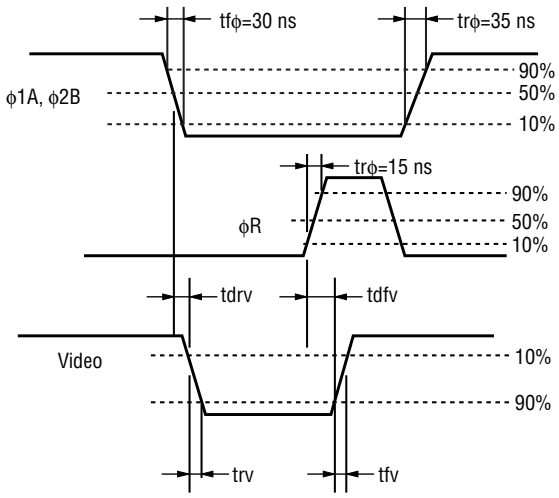
Parameter	Symbol	Gvaranteed Values			Unit	Note
		Min.	Typ.	Max.		
Video Rise Delay Time	tdrv	—	55	—	ns	—
Video Rise Time	trv	—	55	—	ns	—
Video Fall Delay Time	tdfv	—	15	—	ns	—
Video Fall Time	tfv	—	30	—	ns	—

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

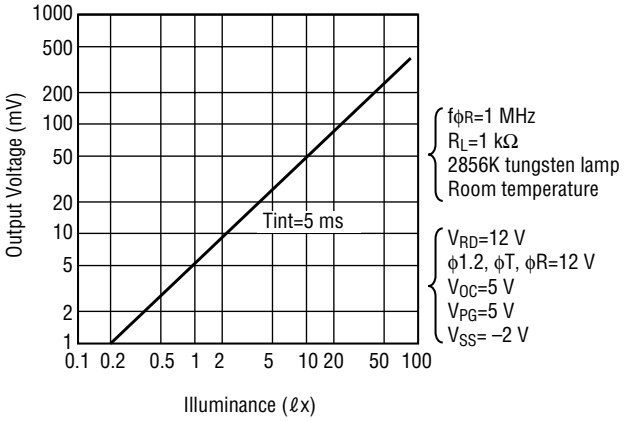


Output Timing Diagrams

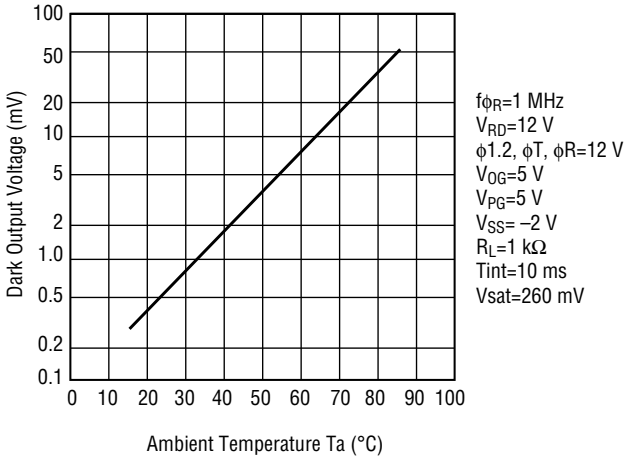


TYPICAL CHARACTERISTICS

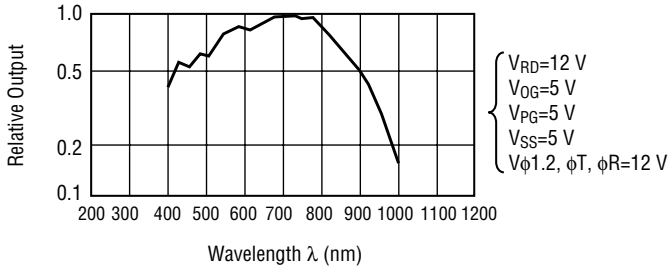
- **Photoelectric Conversion Characteristic**



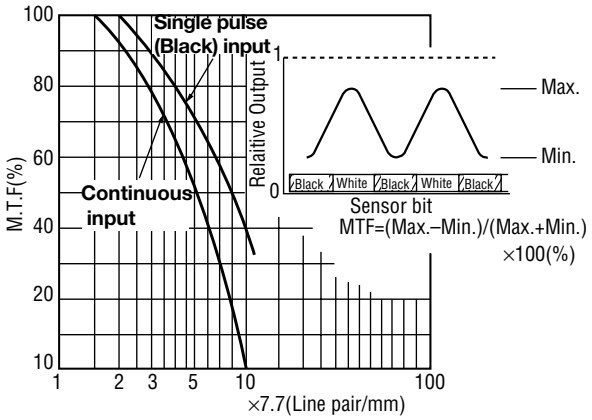
- **Dark Output Voltage vs. Temperature Characteristic**



- **Spectral Sensitivity Characteristic**



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



DRIVE CIRCUIT