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CCD Image Sensors

IL-C6 TURBOSENSOR™

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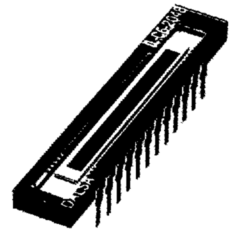
IL-C6-2048 Linear Image Sensor for Spectroscopy Applications

T-41-55



FEATURES

- **High Aspect Ratio**
- **20 MHz Effective Data Rate on a Single Output**
- **13 μm (H) x 500 μm (V) Pixel Size**
- **Electronic Shutter for Exposure Control**
- **Excellent Uniformity**
- **Antiblooming**

DESCRIPTION

DALSA's IL-C6-2048 linear CCD image sensor is designed for high resolution spectroscopic applications, and uses a special reset gate structure to achieve excellent uniformity. The TURBOSENSOR™ technology of the sensor provides a data rate of 20 MHz on a single output. The dynamic range of the photoelements exceeds 10,000:1 and provides output which is linear for all light levels. White reference signals can be generated on the output, providing a reference level and an end-of-frame function. Exposure control is incorporated to allow integration times shorter than the readout times and to reduce image lag.

APPLICATIONS

The IL-C6-2048 sensor is ideally suited for spectroscopy applications and for applications requiring maximum sensitivity and high resolution. The IL-C6-2048 provides over 400 points- per-inch resolution across five inches.

For mechanical information regarding package size and tolerance, refer to package #50-01-24005 in **Optical and Mechanical Considerations of Sensors** on pp. 101-104 of this databook.

Customer support for DALSA's sensors, boards and cameras is available from DALSA's application engineers.

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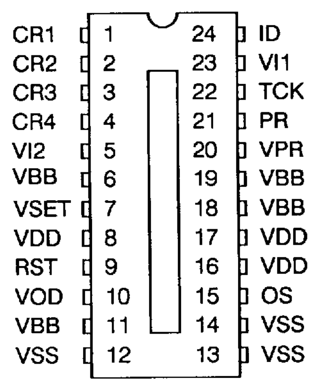
IL-C6 SERIES PIN FUNCTIONAL DESCRIPTION

PIN	SYMBOL	NAME
1	CR1	Readout Clock, Phase 1
2	CR2	Readout Clock, Phase 2
3	CR3	Readout Clock, Phase 3
4	CR4	Readout Clock, Phase 4
5	VI2	White Reference, Input 2
6,11	VBB	Substrate Bias Voltage
7	VSET	Output Node Set Voltage
8	VDD	Amplifier Supply Voltage
9	RST	Output Reset Clock
10	VOD	Output Drain Bias Voltage
12,13,14	VSS	Ground Reference
15	OS	Output Signal
16,17	VDD	Amplifier Supply Voltage
18,19	VBB	Substrate Bias Voltage Bias
20	VPR	Pixel Reset Bias
21	PR	Pixel Reset Clock
22	TCK	Transfer Clock
23	VI1	White Reference Input 1
24	ID	Electrical Reference Diode Input



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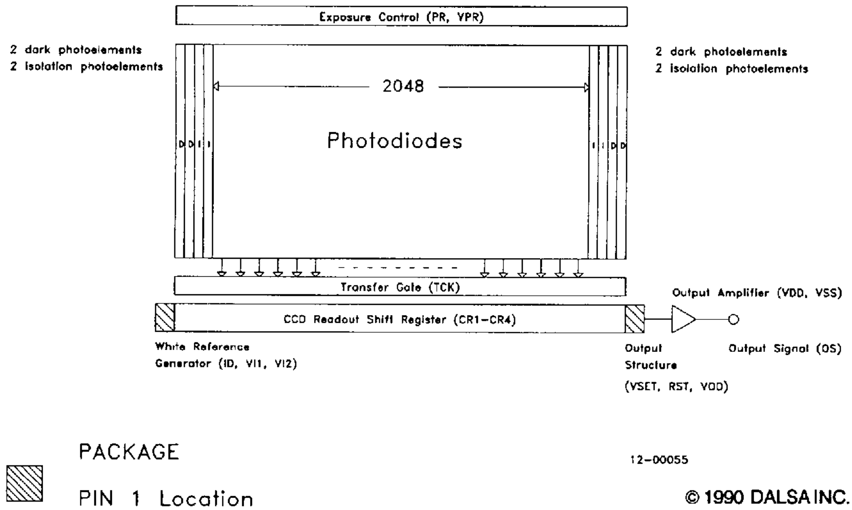
IL-C6 IMAGE SENSOR BLOCK DIAGRAM



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FUNCTIONAL DESCRIPTION

PHOTOELEMENTS

The IL-C6 sensor consists of a line of 2048 active photoelements enclosed at each end by 2 isolation photelements and 2 dark reference photoelements. Each photelement has a center-to-center spacing of 13μm. Each photoelement is 500μm high for a total area of 6,500 microns square.

The TURBOSENSOR™ photoelement offers ultra high speed operation and responds linearly with respect to input light intensity. An electronic shutter exists for exposure control and reducing image lag.

TRANSFER GATE

This gate controls the flow of light generated signal charge from the photoelements into the CCD shift registers. Electrons from the photoelement are transferred when a high potential (equal to the high clock voltage) is applied to the transfer gate.

CCD SHIFT REGISTERS

A single buried channel CCD signal transport shift register is used to maximize speed, improve charge transfer efficiency and reduce noise.

Four phase clocking is used to transfer the charge in the readout shift register (CR1 - CR4). Each phase can be 50% duty cycle 90° out of phase with the adjacent phase. It is recommended that that the rise fall times of these clocks be 1/6 of the period in order to optimize CTE and eliminate clock coupling to the output.

WHITE REFERENCES

A white reference signal can be created in the first element of the CCD shift registers and is controlled by the input signals VI1, VI2, and ID. The reference pulses occur at the end of the output signal data. Adjustment of the VI1 and VI2 voltages can provide approximately 150% of the maximum video output signal. To disable this feature, VI1 and VI2 can be grounded with ID connected to VDD.

OUTPUT STRUCTURE

The signal charge packets from the transport shift registers are transferred serially, over the SET gate, to a floating sensing diffusion. As the signal charge is received, the corresponding potential on the diffusion is applied to the input of a two stage low noise amplifier structure, producing an output signal voltage (OS). The floating sensing diffusion is cleared of signal charge by the reset gate, driven by the reset clock (RST) in preparation for the subsequent signal charge packet.

The output signal should be buffered for current gain. After buffering, it is recommended that the video signal be AC coupled.

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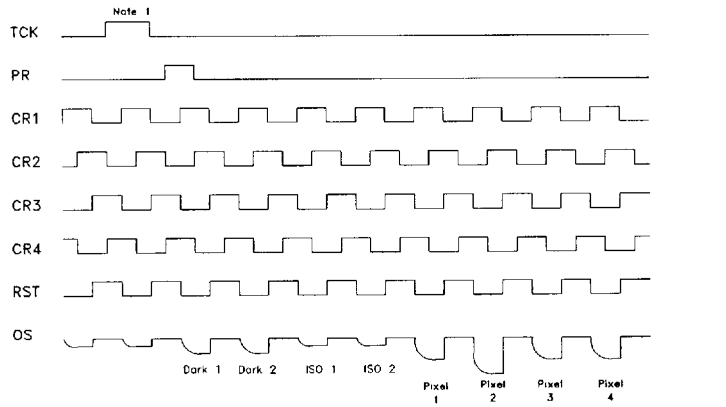
IL-C6 CLOCKING

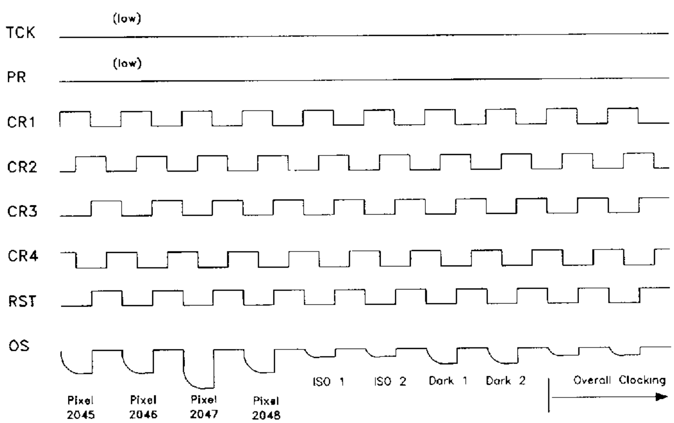
Beginning of Line



NOTES

1) In order to improve sensitivity, this state (TCK high, CR1 high) can be lengthened up to 5 us
2) TCK High should not overlap 2 high periods of CR1. TCK Min = 45 ns
3) TCK falling edge should occur before CR1 falling edge
4) RST falling edge should occur > 0 ns before CR3 falling edge
5) RST minimum High duration > 25 ns
6) ID can be pulsed low while TCK and CR1 are high to provide a white reference

End of Line



NOTES

1) TCK can occur immediately after last dark pixel has been reset
2) ISO = isolation pixel DARK = dark reference pixel
3) Video becomes valid 15 – 20 ns after the falling edge of CR3
4) White reference will occur immediately after the last dark pixel if enabled

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IL-C6 PERFORMANCE CHARACTERISTICS

PARAMETER	MIN	TYP	MAX	UNIT
All specifications are preliminary.				
Recommended Operating Conditions at Tp = 25°C. (See notes).				
Dynamic range[1]		10,000:1		
Saturation Output Amplitude (V_{SAT})[3]		1700		mV
V_{NOISE} [4]				
Peak-Peak		0.8		mV
RMS		0.16		mV
FPN (exposure control disabled)		1.0		mV
FPN (exposure control enabled)		10.0		mV
PRNU (exposure control disabled) [5]		5		% V_{SAT}
PRNU (exposure control enabled) [5]		10		% V_{SAT}
CTE [6]	0 99990	0 99999	0 999999	
DC Output Offset	6	9	10	V
White Reference Amplitude	0	1500	2500	mV
Blooming Suppression	20	100	250	times
Storage Temperature (T_P) [7]	−70		+125	°C
Operating Temperature (T_P) [7]	−60		+90	°C

Notes:

1 Ratio of V_{SAT} to RMS Noise with reset noise eliminated through correlated double sampling (CDS)
2. Responsivity at peak Quantum Efficiency (near 700 nm).
3. Output amplitude with respect to dark reference level
4 Amplifier noise measured with reset noise eliminated through correlated double sampling (CDS)
5 PRNU is measured at approximately 50% V_{SAT} and is the difference between the pixels with the lowest and highest outputs, expressed as a percentage of V_{SAT}.
6 CTE is the measurement for a one stage transfer, measured at f_{RST} = 3.75 MHz
7 T_P is package temperature.

Test Conditions:

1. All tests are done at f_{RST} = 3.75 MHz
2. Light Source QTH lamp with WBHM, unless otherwise noted
3. VDD, VOD = 15 V, VBB = 0 V, Clock high voltage 12 V, low voltage 0 V, (includes CRx, Clx, CSx, TCK, RST as applicable), VSET as required for maximum V_{SAT} and CTE
4. All measurements exclude first and last pixel of each output.

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Optical and Mechanical Considerations of DALSA CCD Image Sensors

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This applications note provides packaging information for the sensors listed in this databook. Please refer to the tables on the following pages for the critical dimensions of each image sensor series. For more information on a particular image sensor, please refer to the specific datasheet.

FIGURE 1. DIMENSIONS OF PACKAGE # 50-01-24005

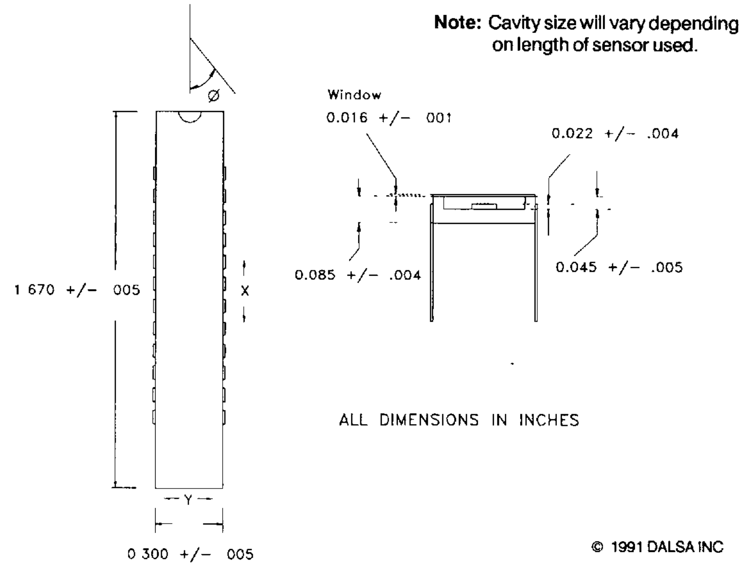

TABLE 1. PACKAGE # 50-01-24005 TYPICAL DIMENSIONS

Package #	Part	X	Y	Ø
50-01-24005	IL-C3-0128	0.55 ± .09	0.15 ± .02	0° ± 3.0°
50-01-24005	IL-C3-0256	0.55 ± .08	0.15 ± .02	0° ± 2.5°
50-01-24005	IL-C3-0512	0.55 ± .07	0.15 ± .02	0° ± 2.0°
50-01-24005	IL-C2-0512	0.55 ± .07	0.15 ± .02	0° ± 2.0°
50-01-24005	IL-C9-0512	0.55 ± .07	0.15 ± .02	0° ± 2.0°
50-01-24005	IL-C4-1024	0.55 ± .05	0.15 ± .02	0° ± 1.5°
50-01-24005	IL-C4-2048	0.55 ± .04	0.15 ± .02	0° ± 1.0°
50-01-24005	IL-C5-2048	0.55 ± .05	0.15 ± .02	0° ± 1.5°
50-01-24005	IL-C5-4096	0.55 ± .04	0.15 ± .02	0° ± 1.0°
50-01-24005	IL-C6-2048	0.55 ± .04	0.15 ± .02	0° ± 1.0°
50-01-24005	IL-E1-0512	0.55 ± .07	0.15 ± .02	0° ± 2.0°
50-01-24005	IL-E1-1024	0.55 ± .05	0.15 ± .02	0° ± 1.5°
50-01-24005	IL-E1-2048	0.55 ± .04	0.15 ± .02	0° ± 1.0°
50-01-24005	IL-F2-0512	0.55 ± .07	0.15 ± .02	0° ± 2.0°
50-01-24005	IL-F2-1024	0.55 ± .05	0.15 ± .02	0° ± 1.5°
50-01-24005	IL-F2-2048	0.55 ± .04	0 15 ± .02	0° ± 1.0°

Note: X = center imaging area to center pin 1 along package Y = center imaging area to center pin 1 across package Ø = off-axis rotation.

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FIGURE 2. DIMENSIONS OF PACKAGE # 50-01-40003

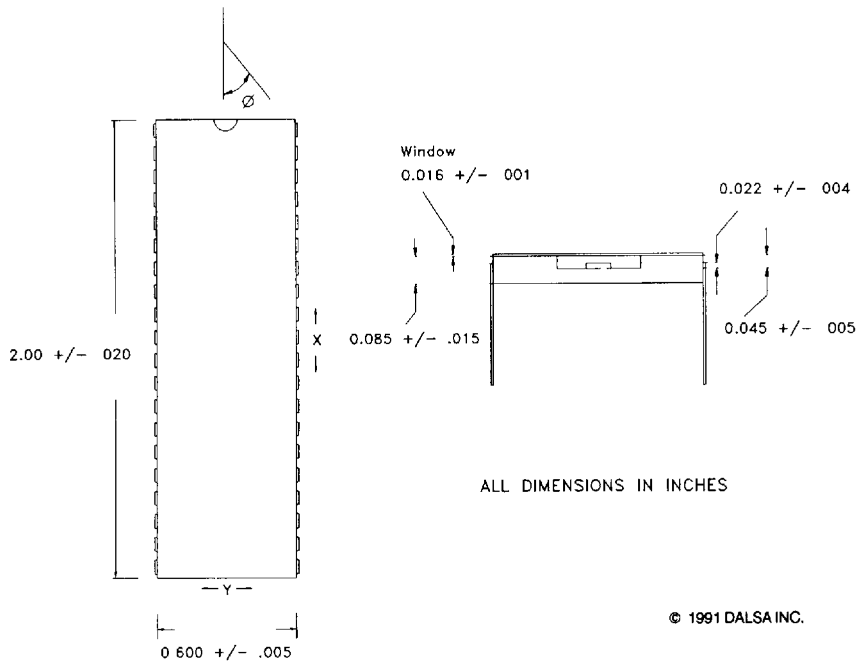

TABLE 2. PACKAGE # 50-01-40003 TYPICAL DIMENSIONS

Package #	Part	X	Y	Ø
50-01-40003	IT-C5-2048	0.95 ± 0.1	0.3 ± 0.05	0° ± 2.5°
50-01-40003	IT-C5-4096	0.95 ± 0.08	0.3 ± 0.03	0° ± 1.5°
50-01-40003	IT-E1-1536	0.95 ± 0.08	0.3 ± 0 05	0° ± 2.0°
50-01-40003	IT-E1-2048	0.95 ± 0.06	0.3 ± 0.05	0° ± 1.5°
50-01-40003	IT-F2-2048	0.95 ± 0.06	0.3 ± 0.03	0° ± 1.5°

Note: X = center imaging area to center pin 1 along package. Y = center imaging area to center pin 1 across package
Ø = off-axis rotation.

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FIGURE 3. DIMENSIONS OF PACKAGE # 50-01-24002

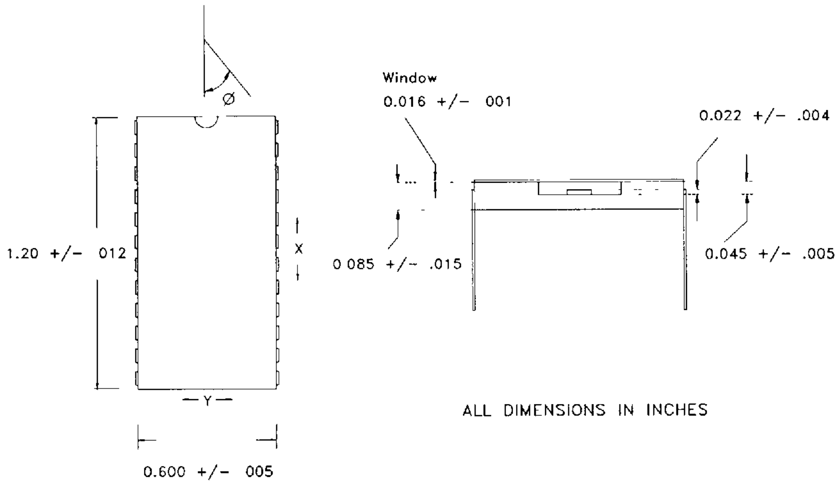

TABLE 3. PACKAGE # 50-01-40002 TYPICAL DIMENSIONS

Package #	Part	X	Y	Ø
50-01-40002	IA-D1-0032	0.56 ± 0.12	0.3 ± 0.05	$0^\circ \pm 5.0^\circ$
50-01-40002	IA-D1-0064	0.57 ± 0.09	0.3 ± 0.04	$0^\circ \pm 4.0^\circ$
50-01-40002	IA-D1-0128	0.59 ± 0.12	0.3 ± 0.03	$0^\circ \pm 2.5^\circ$
50-01-40002	IA-D1-0256	0.71 ± 0.10	0.3 ± 0.03	$0^\circ \pm 1.5^\circ$

Note: X = center imaging area to center pin 1 along package. Y = center imaging area to center pin 1 across package. Ø = off-axis rotation

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FIGURE 4. DIMENSIONS OF PACKAGE # 50-01-28004

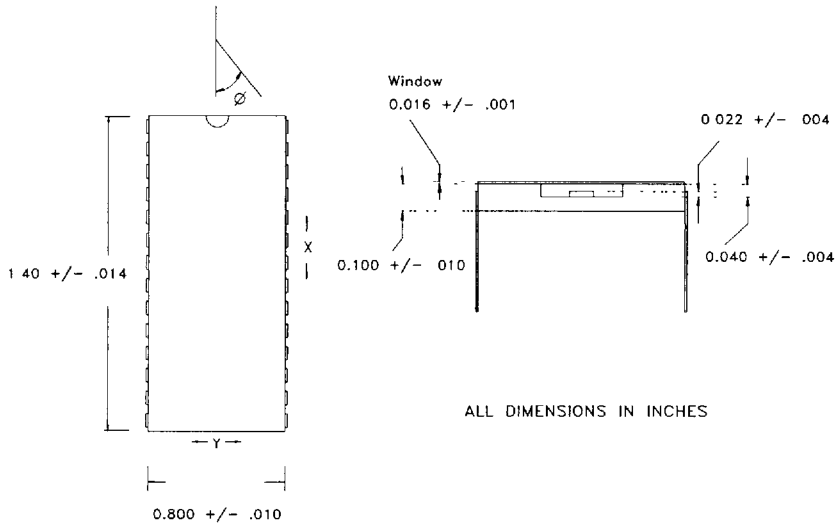

TABLE 4. PACKAGE # 50-01-28004 TYPICAL DIMENSIONS

Package #	Part	X	Y	Ø
50-01-28004	IA-D2-0512	0.65 ± 0.08	0.4 ± 0.04	$0^\circ \pm 3.0^\circ$

Note: X = center imaging area to center pin 1 along package. Y = center imaging area to center pin 1 across package. Ø = off-axis rotation