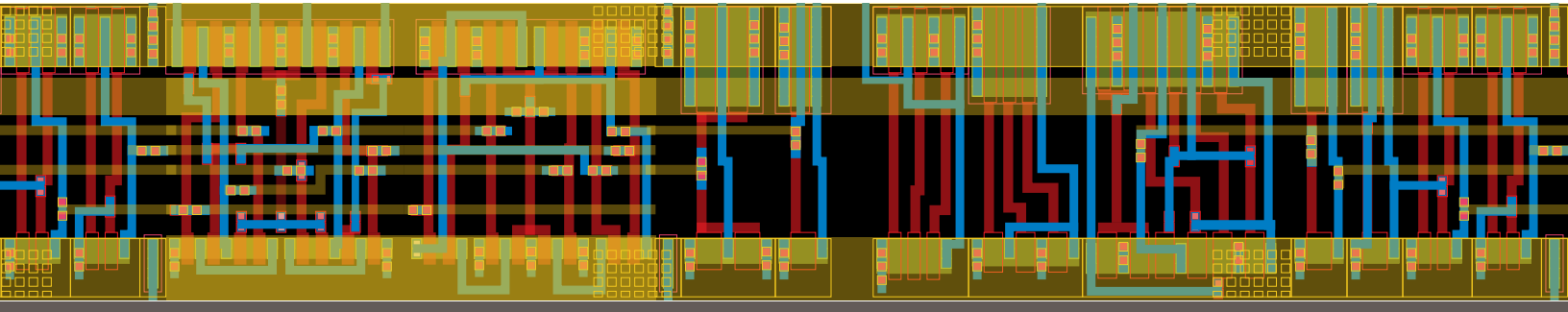


# Mid-Format Readout Integrated Circuits



At the heart of today's high-resolution vision systems

## Readout Integrated Circuits

If you're designing imaging systems for Infrared, Visible, Ultraviolet, X-Ray, or Gamma Ray detection, FLIR's mixed-signal Readout Integrated Circuits (ROICs) offer a proven design without the schedule, resources, and risk of a custom development. Our line of ROIC products provides an off-the-shelf solution for applications requiring low noise, variable charge storage capacitance, selectable integration times, adjustable gain and power settings, and a simple user interface.

## 2-Dimensional Arrays

Our family of 2-dimensional mid-format arrays includes the ISC9705, ISC9809, ISCO903, and ISCO208. These arrays make excellent imagers for camera products, and are used in many of FLIR's IR imaging systems. The ISC9809, with ultra-low noise and low background sensitivity, is ideal for spectroscopy and astronomy applications. It's also compatible with ultra-violet and visible sensors.

The ISCO903 is a two-color, dual polarity device for use with p-on-n or n-on-p detectors such as strained-layer superlattice devices. It is based on the ISC9705, so the pixel pitch is identical and interface is similar. The ROIC has been specifically designed to allow for both polarities of detectors to be placed back-to-back and to connect to the ROIC through one input pad to obtain a two-color image.

### Key Features:

- Formats include 320 x 256, and 384 x 288 elements
- Designed for use with infrared detectors including InSb, QWIP, MCT, SLS, and InGaAs
- Common electrical interfaces and features

## Linear Array

Our linear array, the ISC9802, is a 512 x 1 device for photodiodes. It is ideal for use in spectroscopy systems and DWDM channel monitors.

### Key Features:

- Supports both wire- and bump-bonding detector interfaces
- User-configurable as a 512 x 1, 256 x 1, or 128 x 1 array
- Low noise, low input impedance front end, correlated double sampling stage, and wide range of selectable integration capacitors

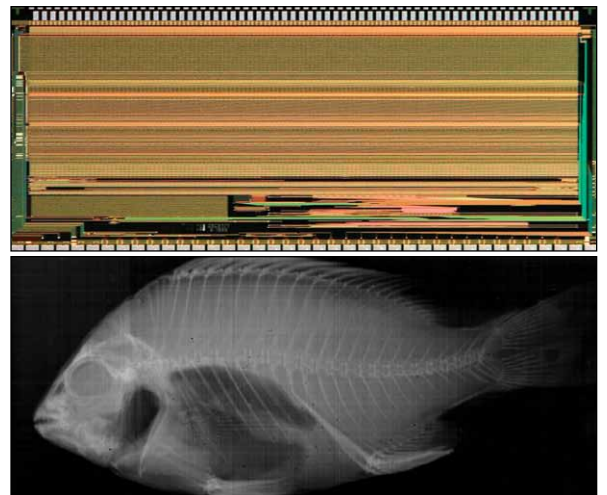
## X-Ray Devices

The ISC9717, our 128 x 1 ROIC for X-Ray detection systems, offers the ultimate in flexible architecture. It supports applications involving digital radiography, mammography, fluoroscopy, angiography, tomography, non-destructive testing, or industrial instrumentation.

The ISC9717 is ideal for X-Ray medical imaging applications, from high-resolution radiography in single frame mode to fluoroscopy with frame rates up to 30 Hz.

### Key Features:

- Designed for use with Se, CsI, Si, Amorphous Si, GaAs, and CdZnTe detectors
- Adjustable parameters for integration capacitor selection, low-pass filter time constant, gain, integration mode, ADC resolution, and readout direction
- Designed for abutting multiple chips to read out large array flat panel X-Ray detector panels



ISC9717 ROIC and X-Ray image of a scup taken by tiling two 1024 x 1024 frames horizontally.

## Delivery

Standard ROIC devices are delivered in wafer form, probe tested, and labeled according to pass/fail criteria. Test data is included on CD-ROM for each device. A User Guide is provided that describes all device electrical interfaces. A Mechanical Interface Database provides the layout information needed by customers to design their detector interface.

If our standard ROIC products do not meet your requirements, we offer full custom design services, from trade study through design and fabrication of wafers.



ROICs in wafer form with test data CD

## Standard Readout Functions

	ISC9705	ISC9809	ISC0903	ISC0208	ISC9802 (linear array)	ISC9717 (linear X-Ray)
<b>Array Size</b>	320 × 256	320 × 256	320 × 256	384 × 288	512 × 1 (256 × 1, 128 × 1)	128 × 1
<b>Pixel Pitch</b>	30 μm	30 μm	30 μm	25 μm	25 μm 50 μm 100 μm	80 μm
<b>Input Circuit</b>	Direct Injection	CTIA	Direct Injection	Direct Injection	CTIA	CTIA
<b>Integration Type</b>	Snapshot mode	Snapshot mode	Snapshot mode	Snapshot mode	Snapshot mode	Snapshot mode
<b>Integration Time</b>	Adjustable integration time > 5 μs	Adjustable integration time > 0.5 μs*	Adjustable integration time > 100 μs	Adjustable integration time > 9.6 μs	Adjustable integration time > 0.2 μs	Adjustable integration time 24 μs to few μs
<b>Integration Modes</b>	Integrate- While-Read Integrate- Then-Read	Integrate- While-Read Integrate- Then-Read Non-destructive readout Continuous integ. with multiple readout	Integrate- While-Read Integrate- Then-Read	Integrate- While-Read Integrate- Then-Read	Integrate- While-Read Integrate- Then-Read	Integrate- While-Read Integrate- Then-Read
<b>Gain Adjustment</b>	2 bit (1, 1.3, 2, or 4x)	1 bit (1, 20x)	N/A	2 bit (1, 1.3, 2, or 4x)	3 bit integ. capacitor 2 bit CDS gain (1, 1.3, 2, or 4x)	3 bit integ. capacitor 4 bit CDS gain (1, 2, 4, 8, or 32x)
<b>Operational Modes</b>	"Hands-off" default, or user configurable	"Hands-off" default, or user configurable	"Hands-off" default, or user configurable	"Hands-off" default, or user configurable	"Hands-off" default, or user configurable	Programmable Low Pass Filter Programmable 9- to 14-bit ADC
<b>Windowing</b>	Dynamic windowing	Dynamic windowing	Dynamic windowing	Dynamic windowing	N/A	Adjacent channel averaging mode
<b>Readout Modes</b>	Invert [row] Revert [column] Inverse [row-column] Line repeat mode	Invert [row] Revert [column] Inverse [row-column] Line repeat mode	lInvert [row] Revert [column] Inverse [row-column]	Invert [row] Revert [column] Inverse [row-column]	N/A	N/A
<b>Number of Outputs</b>	Selectable 1, 2, or 4 Refer. output	Selectable 1, 2, or 4 Refer. output	Selectable 1, 2, or 4 Refer. output	Selectable 1, 2, or 4 Refer. output	1 or 2 (odd/even) for 512 Refer. output	Parallel output 9 to 14 bits (current mode)
<b>Detector Application</b>	p-on-n	p-on-n or n-on-p	n-on-p or p-on-n	p-on-n	p-on-n or n-on-p	Hole or e <sup>-</sup> collection, direct or indirect detector interface

\*Dependent on operating temperatures and internal bias and amplifier settings.

## Specifications

	ISC9705	ISC9809	ISC0903	ISC0208	ISC9802 (linear array)	ISC9717 (linear array)
<b>Array Size</b>	320 x 256	320 x 256	320 x 256	384 x 288	512 x 1	128 x 1
<b>Pixel Pitch</b>	30 µm	30 µm	30 µm	25 µm	25 µm, 50 µm, 100 µm	80 µm
<b>Operating Temperatures</b>	77 to 310 K	77 to 310 K	65 to 300 K Stability <0.1 K	77 to 310 K	77 to 340 K	283 to 333 K
<b>Detector Bias Range</b> ( $I_{det} = 1\text{ nA}$ )	-0.10 V to 0.5 V <sup>+</sup> (up to 0.8 V)	0 to 2.5 V	50 mV to -800 mV (p on n) -50 mV to +800 mV (n on p)	0 to 0.5 V <sup>+</sup>	-0.25 V to 0.25 V Uniformity ≤ 250 µV	1.5 to 3.5 V
<b>Detector Bias Resolution</b>	5 mV	External adjust	8 mV bit bias or external adjust	5 mV	External adjust	External adjust
<b>RoA Min.</b>	≥1 x 10 <sup>3</sup> Ω·cm <sup>2</sup>	≥10 x 10 <sup>7</sup> Ω·cm <sup>2</sup>	≥1 x 10 <sup>3</sup> Ω·cm <sup>2</sup>	≥1 x 10 <sup>3</sup> Ω·cm <sup>2</sup>	≥1 x 10 <sup>10</sup> Ω·cm <sup>2</sup>	N/A
<b>Detector Capacitance Max.</b>	≤0.5 pF	≤0.1 pF	≤0.6 pF	≤0.5 pF	<10 pF	≤50 pF
<b>Well Capacity</b> (Min-Max Gain)	18 x 10 <sup>6</sup> e <sup>-</sup> 13.5 x 10 <sup>6</sup> e <sup>-</sup> 9 x 10 <sup>6</sup> e <sup>-</sup> 4.5 x 10 <sup>6</sup> e <sup>-</sup>	3.5 x 10 <sup>6</sup> e <sup>-</sup> 0.17 x 10 <sup>6</sup> e <sup>-</sup>	18 x 10 <sup>6</sup> e <sup>-</sup>	18.5 x 10 <sup>6</sup> e <sup>-</sup> 13.9 x 10 <sup>6</sup> e <sup>-</sup> 9.3 x 10 <sup>6</sup> e <sup>-</sup> 4.6 x 10 <sup>6</sup> e <sup>-</sup>	256 x 10 <sup>6</sup> e <sup>-</sup> to 2 x 10 <sup>6</sup> e <sup>-</sup> (in 8 increments)	75 x 10 <sup>6</sup> e <sup>-</sup> to 9.3 x 10 <sup>6</sup> e <sup>-</sup> (in 8 increments)
<b>Input Current</b> (Nominal Operating Range)*	1 pA 1 nA 10 nA	0.01 pA 1 pA 50 nA	20 pA 1 nA 10 nA	1 pA 1 nA 20 nA	Depends on T <sub>int</sub>	Depends on T <sub>int</sub>
<b>ROIC Noise</b> (Min. Gain)	≤900e <sup>-</sup> <sub>RMS</sub> *	≤700e <sup>-</sup> <sub>RMS</sub> *	≤80 dB input referred*	≤850e <sup>-</sup> <sub>RMS</sub> *	≤3700e <sup>-</sup> <sub>RMS</sub> (low speed)*	≤17000e <sup>-</sup> <sub>RMS</sub> * (low speed)*
<b>ROIC Noise</b> (Min. Gain)	≤600e <sup>-</sup> <sub>RMS</sub> *	≤70e <sup>-</sup> <sub>RMS</sub> *	N/A	≤570e <sup>-</sup> <sub>RMS</sub> *	≤100e <sup>-</sup> <sub>RMS</sub> (high speed)**	≤2000e <sup>-</sup> <sub>RMS</sub> **
<b>Output Range</b>	3 V	2.7 V	<2.5 V +/-0.2 V	2.5 V	2.5 V	0.5 mA ±10%/bit
<b>Output Interface</b> (R <sub>out</sub> , C <sub>out</sub> )	>100 kΩ ≤25 pF	>500 kΩ ≤25 pF	>100 kΩ ≤12 pF	>100 kΩ ≤25 pF	>100 kΩ ≤25 pF	N/A ≤30 pF
<b>Pixel Rate</b>	10 MHz	10 MHz	6.25 MHz	10 MHz	3.85 MHz (at 77 K) 2.7 MHz (at 300 K)	12.5 MHz
<b>Full Frame Rate</b> (1 output)	110 Hz	110 Hz	≥60 Hz	80 Hz	7.1 kHz (at 77 K) 5 kHz (at 300 K)	0.9 Hz for 14 bit up to 36 Hz for 9 bit
<b>Full Frame Rate</b> (2 outputs)	200 Hz	200 Hz	≥120 Hz	150 Hz	14 kHz (at 77 K) 9.8 kHz (at 300 K)	N/A
<b>Full Frame Rate</b> (4 outputs)	346 Hz	346 Hz	≥240 Hz	260 Hz	N/A	N/A
<b>Power</b> (1 output)	≤30 mW	≤100 mW	≤60 mW	≤75 mW	≤55 mW [256]***	≤256 mW
<b>Power</b> (4 outputs)	≤120 mW	≤175 mW	≤150 mW	≤160 mW	≤110 mW [512]***	≤2 mW per channel

\*Dependent upon T<sub>int</sub> and operating conditions

+ QWIP bias option available  
\*T<sub>int</sub> = 1 msec  
T = 80 K

\*T<sub>int</sub> = 16 msec,  
T = 250 K  
C<sub>det</sub> + C<sub>int</sub> = 0.126 pF  
R<sub>oA</sub> ≥ 5 x 10<sup>4</sup>Ω·cm<sup>2</sup>

\*Based on T<sub>int</sub> = 3.75msec, 77 K,  
C<sub>det</sub> = 0.6pF  
R<sub>oA</sub> ≥ 1.0 x 10<sup>3</sup>Ω·cm<sup>2</sup>

\*theoretical, no detector or system noise  
+ QWIP bias option available

\*T<sub>int</sub> = 10 msec,  
T = 300 K,  
C<sub>det</sub> = 0.5pF  
\*\*T<sub>int</sub> = 0.2 msec,  
T = 80 K, no CDS,  
ITR, C<sub>det</sub> = 0.5pF  
\*\*\* T = 300 K  
(x1.4 @77K)

\*C<sub>int</sub> = 4pF,  
x1 CDS, 14 bit ADC,  
C<sub>det</sub> = 50pF  
\*\*C<sub>int</sub> = 0.5pF,  
x32 CDS, 9 bit ADC,  
C<sub>det</sub> = 50pF



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