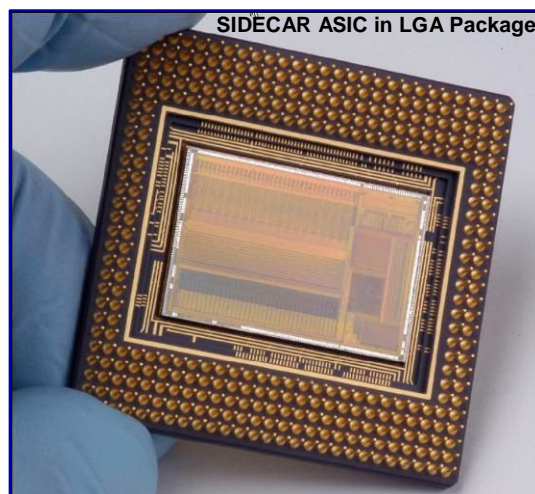# Teledyne Imaging Sensors
# SIDECAR™ ASIC
# Development Kit & Focal Plane Electronics

**The SIDECAR™ ASIC is designed to manage all aspects of imaging array operation and output digitization.**

## SIDECAR™ ASIC Hardware:

- 36 analog to digital processing channels
  - Accommodates all 32 outputs of a H2RG™ focal plane array, plus reference output, window output, and temperature sensor
  - Adjustable Pre Amp gain (11 unique settings)
  - 16 bit analog-to-digital converter (ADC): up to 500 kHz sample rate
  - 12 bit ADC: up to 10 MHz sample rate
- Clock generation
  - 32 programmable digital I/O signals
- Bias generation
  - 20 programmable bias voltages/currents
- Digital interface to instrument electronics
  - 24 digital input/output channels for data transfer (LVDS or CMOS)
- 16-bit fully programmable microcontroller
- Low power operation
  - Less than 300mW, 32 channel, 16 bit ADC sampling at 100 kHZ
  - Less than 1 W, 32 channel, 12 bit ADC sampling at 10 MHZ
  - Flexible power-down modes
- Requires one power supply, one fixed reference and one master clock for operation



SIDECAR ASIC in LGA Package

The SIDECAR™ ASIC has been designed as compact focal plane electronics on a single chip for Teledyne Imaging Sensor's H1RG™ and H2RG™ focal plane arrays supporting all possible modes of operation. The SIDECAR™ ASIC also supports the 16-megapixel H4RG-10 as well as the 16-megapixel H4RG-15 focal plane arrays when operating in 32 output mode, where -10 and -15 denote the pixel pitch in microns.

The SIDECAR™ ASIC is also being used as a control and data acquisition system for general imaging applications including those utilizing CCDs. The SIDECAR™ ASIC development kit and focal plane electronics provides a powerful, low-cost, highly flexible, small footprint, and low-power solution for ground-based applications as well as the development platform for airborne and space-based applications. Teledyne is supporting more than 120 SIDECAR™ ASIC kits around the world.

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# SIDECAR™ ASIC Software Suite:

Teledyne provides a proven and comprehensive software suite that supports both 32 bit and 64 bit operating systems and includes a graphical user interface (GUI), an integrated development environment (IDE), a socket server for interface WINDOWS operating systems, and machine code that supports most standard readout modes.

The SIDECAR™ ASIC software suite included in the development kit and focal plane electronics supports the following modes:

- Full-field, slow readout (up to 480 kHz per output) mode for H1RG, H2RG, and H4RG
- Selectable number of outputs
- Correlated double sampling, Fowler sampling, and up-the-ramp sampling
- Window operation
- Programmable clocking modes (normal and enhanced clocking)
- Programmable reset modes: Pixel by Pixel, Line by Line, and Global
- Single-ended and differential pixel readout
- Functions for system and multiplexer / readout integrated circuit gain calibration
- Telemetry reporting in date file headers
- Support for external shutter and pulse triggers
- Socket Server interface supported in Windows via TCP/IP
- Interleaved reference pixel scheme for H4RG-15
- Separate reference pixel output
- Sub-frame and sub-row integration times*
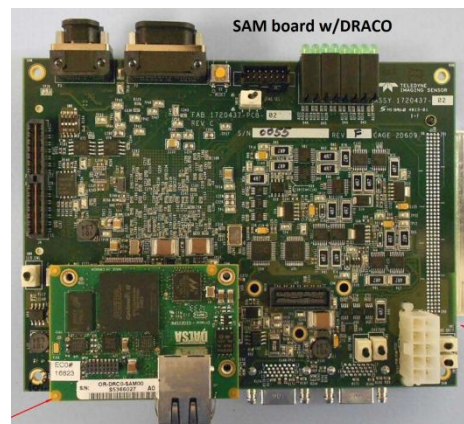- Fast mode readout (up to 10 MHz per output)*

Custom SIDECAR™ ASIC assembly code can be developed to enable additional functions and features of the family of HxRG (x = 1, 2, and 4) focal plane array products as well as for other imaging arrays including CCDs.
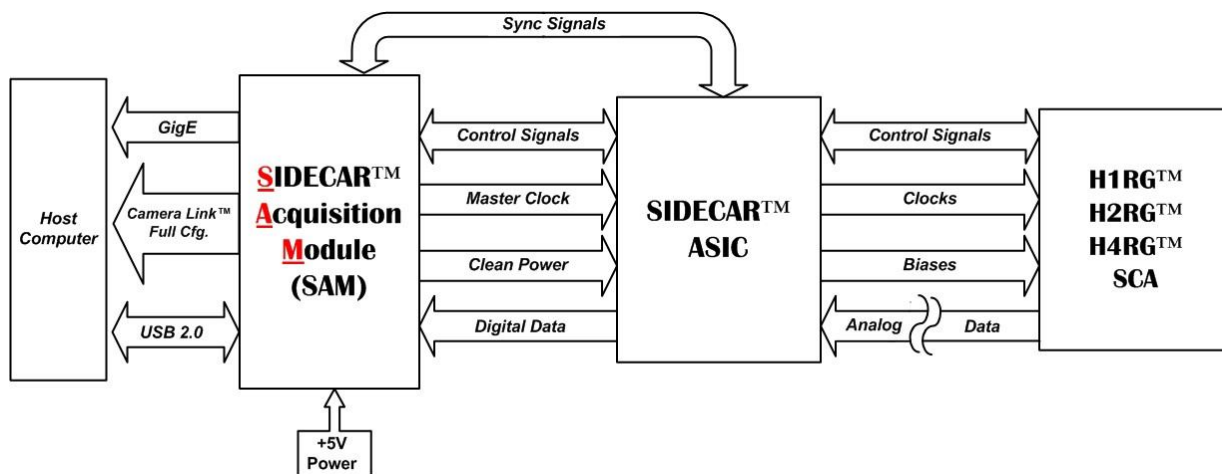
* A custom solution is needed to fully utilize these features.

# SIDECAR™ Acquisition Module (SAM):

The SIDECAR™ Acquisition Module (SAM) is the successor to the JADE-2 card and is used to control the SIDECAR™ ASIC. The SAM preserves all the features of the JADE-2 card and adds the following features:

- Supports both Fast and Slow modes of the H1RG™, H2RG™ and the H4RG™ FPAs without a need to reload firmware or having to reset the SIDECAR™ ASIC (real time mode switching)

- SIDECAR™ ASIC operation at full data rates

- Integrates Camera Link™ Full Interface into a single board and continues to support USB 2.0 (Windows OS)

- Supports Gigabit Ethernet using Gig-E Vision protocol (Linux)



SAM board w/DRACO

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*Block diagram showing the data and signal flows*

# SIDECAR™ ASIC Kit Standard Configurations:

The SIDECAR™ ASIC kit is offered in two configurations: A room-temperature (RT) development kit (configuration K1), and a cryogenic single SIDECAR™ ASIC focal plane electronics (FPE) kit (configuration K2).

The RT kit (configuration K1) is a laboratory/demonstration system designed for flexibility and testability; it is not optimized for performance.

The cryogenic single SIDECAR™ ASIC FPE kit (configuration K2) is optimized for low-noise and low-power performance of the HxRG family of focal plane arrays in slow mode operation, i.e. up to 480 Kilopixel / second / output, up to 32 outputs. Although the cryogenic single SIDECAR™ ASIC FPE also supports fast mode operation with readout rates of up to 5 Megapixel / second / output (up to 32 outputs), the effective data rate the system supported through a USB 2.0 link is 10 Megapixels per second.

The RT development kit and the SIDECAR™ ASIC cryogenic FPE kit are complete solutions, i.e. all hardware and software needed to operate a focal plane array are provided. The table and figures below show the complete set of standard kit, sub-assembly, and component configurations offered by Teledyne Imaging Sensors.

| STANDARD KITS | |
|---|---|
| K1 | SIDECAR ASIC Room-Temperature (RT) Development Kit |
| K2 | Cryogenic Single SIDECAR ASIC Focal Plane Electronics (FPE) |

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**Standard SIDECAR K1 Room Temperature Kit**
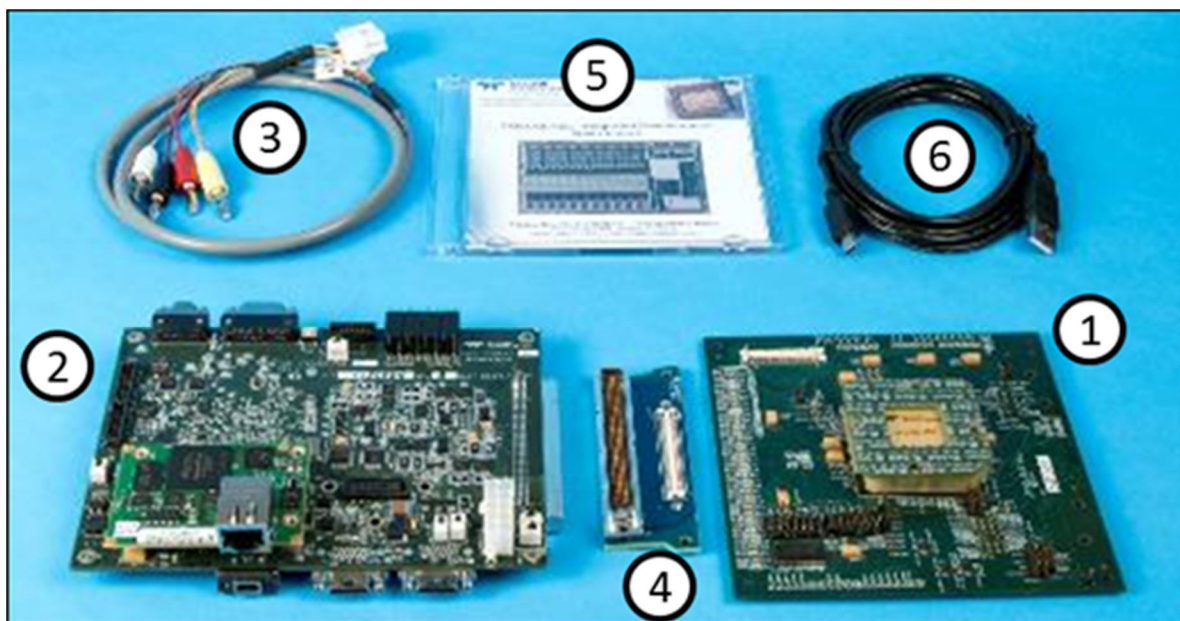


1.  Single ASIC assembly w/socket, P/N 1720539-01
    – SIDECAR ASIC, 337-LGA, cavity down, P/N 1400012-01
    – Single ASIC Type 8 warm development board assy, P/N 1720234-01
2.  SAM w/Draco Gig E*, P/N 1700006-01
3.  SAM power cable, P/N 1760003-01 (10 pin)
4.  Adapter card: SAM-to-Hirose "blue" adapter, P/N 1720473-01
5.  Test Data & Software CD
6.  USB 2.0 mini cable, P/N AE9929-ND

*Also sold as stand-alone standard product serialized item.

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## Standard SIDECAR K2 Cryogenic Kit
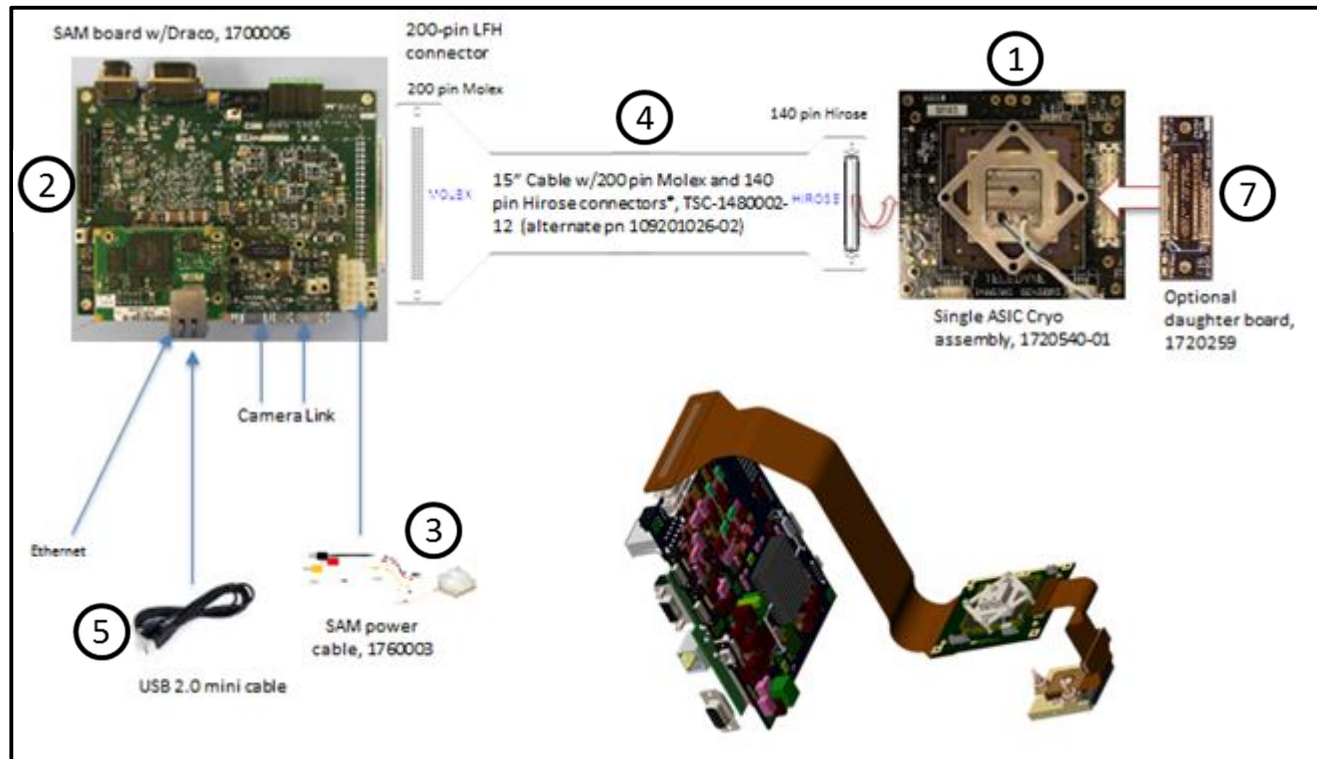


1. Single ASIC Cryo assembly w/socket & cold clamp, P/N 1720540-01
    a. SIDECAR ASIC, 337-LGA, cavity down, P/N 1400012-01
    b. Single ASIC Cryo board assy, P/N 1720174-029 (bare PWB P/N 1720175)
    c. Cold clamp, P/N 102062100
    d. Cinch Socket, P/N 390-02-20-023
2. SAM w/Draco Gig E*, P/N 1700006-01
3. SAM power cable, P/N 1760003-01 (10 pin)
4. 15" Cable w/200-pin Molex/140-pin Hirose connectors*, P/N 1480002-12 (alt P/N 109201026-02)
5. USB 2.0 mini cable, P/N AE9929-ND
6. Test Data & Software CD (not shown above)
7. Optional Daughter Board**, P/N 1720259-0X

*Also sold as stand-alone standard product serialized items.
**Optional Daughter Board sold separately.

## SIDECAR™ Training and Support Services:

To ensure that SIDECAR<sup>TM</sup> ASIC products satisfy our customers' needs, Teledyne Imaging Sensors offers optional training and support services via telephone and email, or on-site. Among the services offered are software installation and interfacing support, hardware interfacing support, and user training. Training and support are customized depending on the user's needs. Contact Teledyne Imaging Sensors for more information and pricing.

## Acronyms:

- **ASIC**: Application Specific Integrated Circuit
- **CCD**:  Charge Coupled Device
- **CMOS**: Complementary Metal–Oxide–Semiconductor
- **FPE**: Focal Plane Electronics
- **HxRG (HAWAII-xRG)**: HgCdTe Astronomy Wide Area Infrared Imager with xK by xK pixels, Reference pixels, and Guide mode; x = 1, 2, and 4
- **IDE**: Integrated Development Environment
- **LVDS**: Low-Voltage Differential Signaling
- **SAM**: SIDECAR Acquisition Module
- **SIDECAR**: System for Image Digitization Enhancement Control And Retrieval

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