Osiris
PMC/PCI High-performance, Dual-channel Radar Interface

**Overview**
Osiris is a high-performance, dual-channel radar interface board that accepts and processes analog and digital radar signals and provides a PCI interface to applications. Osiris comes from a long history of radar interface products at Curtiss-Wright, with interfaces to support many legacy and modern radar types. With an on-board FPGA and high-speed PCI interface, Osiris offers high performance with two independent channels on a half-length PCI or PMC mezzanine format.

**Operation**
Osiris receives all radar video, triggers and azimuth data from a front-panel connector. It can generate two streams of radar video onto the PCI bus. Each of the two streams can process data from a combination of the analog and digital inputs, using one of two sets of trigger and turning data. This allows the card to process a pair of radar videos derived from a single set of azimuth turning data and triggers, or else to process two separate videos derived from two independent radars with their own trigger and turning data.

Capture of the video data into fixed-length returns is initiated by the radar’s trigger (sync) signal. Data capture starts at a programmable delay from the active edge of the trigger, with video data processed in range and azimuth to combine multiple samples and returns. In range, the card samples video at up to 50 MHz, reducing the data down to a defined number of samples per return to match...
the bandwidth of the incoming video. In azimuth, the card can be programmed to either output every return, or else to combine returns to output a set number per scan, typically 1024, 2048 or 4096. In this mode returns are correlated, typically using a highest-wins combiner, to get the correct number of output azimuths.

Packets of video data are defined with a header and data block and are transferred to the PCI bus with DMA transfers. Osiris is available with a board-support library for integration into custom applications, or else can be supplied with Curtiss-Wright’s own Radar Video Processor (RVP) as part of a radar acquisition, processing, distribution or tracking application. The diagram below shows the Osiris PCI card used in a typical radar acquisition and display system.

Figure 1: Typical Osiris Radar System Configuration
Figure 2: Osiris Block Diagram

- Radar Video 2x ADC’s
- Digital Inputs 2x Sync 2x ACP 2x ARP 2x CLK 8x Digital
- Digital Thresholds DAC
- FPGA
  - Returns Buffer 2x 16 Kbytes
  - Control Registers
  - LUTS
- CPLD (FPGA Configuration update)
- JTAG PORT
- Configuration Device
- 4 MByte Dual-port SRAM 1 Mb x 32
- 32-bit 66 MHz

Figure 3: Osiris Internal FPGA Processing

- Test Pattern Generator
- Analog 1 10-bit
- 10-bit MUX 2-1
- Adjustable Low/high pass
- Digital input MUX and Delay
- Digital 2 10-bit
- 10-bit MUX 2-1
- Adjustable Low/high pass
- Azimuth Decode Channel Selection ACP/ARP RADDs ANUYQ-21
- Gain and Offset LUT 10-8-bit
- Sub Sample
- Sub Sample
- Mixer
  - Gain and Offset LUT 4 Kbytes + Other
- Sub Sample
- Sub Sample
- Gain Offset LUT 4 Kbytes
- Delayed 8
- Sub Sample
- Sub Sample
- Gain Offset LUT 4 Kbytes
- Return Valid 1 & 2
- Sample Frequency Generation, Start Delay & Range Counter
- Returns Offload
  - Azimuth Time Stamp
  - RACE?
- Returns Buffer
  - Azimuth Correlation 2x (2K + 17 Kbytes) 304 Kbits

System Clock PLL’s
- 50 MHz in
- 66 MHz in
- 2x 50 MHz ADC
- 100 MHz DP
- Sync 1
- Sync 2
- System Clock
- 2x System CLK
- local Bus CLK
- RADDS
- Sync Control Channel Select
- Time stamp
- Sync start 1 & 2
- 2x Clocks
- ACP/ARP Diff/Single 1
- ACP/ARP Diff/Single 2
- Digital x8 Differential
- Digital x16 Single
- Clock Sync
- 12-bit Parallel
- /8 + /8
- Delayed 8
- Radix 2
- Digital LUT 8-8-bit
- Non-linear LUT 10-8-bit
- Non-linear LUT 10-8-bit
- Gain and Offset Range
- Gain and Offset WRT
- Sub Sample
- Delayed 8
- Conditioned Azimuth 1 & 2 + RADDS Full Decode
- Delayed 8
- Sample Frequency Generation, Start Delay & Range Counter
- Debug and Test Registers
- Control Registers and Memory Mapping for LUTS
- DAC Threshold Control
- JLADSR SRAM
- Local bus
- Dual Port SRAM
- Returns Offload Control
- Azimuth Time Stamp
- RACE?
Figure 4: Osiris Video Stream Processing

![Diagram of Osiris Video Stream Processing](image-url)
Osiris Video Streams

Osiris supports two video output streams, Stream A and Stream B – see Figure 4. The video data associated with each stream is derived from a combination of the two Analog inputs and 8-bits of digital video. With reference to Figure 4, Combiner A accepts three digitized video inputs, X, Y and D0-D3, and Combiner B accepts X, Y and D4..D7. Each of X and Y itself is derived by digitally processing (filtering and gain-with-range adjustment) either an Analog or digital input. X is derived by processing either Analog 1 or 8 digital inputs – the choice being made by Selector 1. Similarly Y is derived by processing either Analog 2 or the same 8 digital inputs.

The A and B Combiners are configured with software to output a combination of X, Y and 4-bits of digital input. The following modes are supported for Stream A:

Stream A = X
In this mode, Stream A is X, where X is derived from either Analog 1 or the 8 digital inputs.

Stream A = MAX (X, Y)
In this mode, Stream A is a highest wins combination of the X and Y inputs. X could be derived from Analog 1 or the 8 digital inputs, and Y could be derived from Analog 2 or the same 8 digital inputs. The highest-wins combination operates on every sample of the return and outputs the sample having the larger value.

Stream A = MIN (X, Y)
In this mode, Stream A is a lowest wins combination of the X and Y inputs. X could be derived from Analog 1 or the 8 digital inputs, and Y could be derived from Analog 2 or the same 8 digital inputs. The lowest-wins combination operates on every sample of the return and outputs the sample having the smallest value.

Stream A = AVERAGE (X, Y)
In this mode, Stream A is the average of the X and Y inputs.

Stream A = LUT (X, D0..D3)
In this mode, Stream A is output as a combination of the X input and 4-bits of digital video D0..D3. A look-up table (12-bits) is used to create an 8-bit value from the combination of 8-bits of Analog and 4-bits of digital. It should be noted that the digital bits are direct from the input and are not subject to the filtering or gain adjustment that happens on the X/Y processing.

Stream B supports similar processing. Using the Combiners and the Selectors under software control, a number of options are available for Streams A and B. Some typical scenarios are shown in the table 1 below.

### Table 1: Typical configurations

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Selectors</th>
<th>Combiners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog Video 1 on Stream A, Analog Video 2 on Stream B</td>
<td>Selector 1 = Analog, Selector 2 = Analog</td>
<td>Combiner A = X, Combiner B = Y</td>
</tr>
<tr>
<td>Analog Video 1 on Stream A, Digital Video 2 on Stream B</td>
<td>Selector 1 = Analog, Selector 2 = Digital</td>
<td>Combiner A = X, Combiner B = Y</td>
</tr>
<tr>
<td>Analog Video 1 on Stream A, Analog Video 2 on top 4-bits of Stream B, Digital Video inputs on lower 4-bits of Stream B</td>
<td>Selector 1 = Analog, Selector 2 = Analog</td>
<td>Combiner A = X, Combiner B = LUT (Y, D4..D7)</td>
</tr>
<tr>
<td>Digital Video (4-bits) on Stream A, Highest wins of Analog 1 and 2 on Stream B</td>
<td>Selector 1 = Analog, Selector 2 = Analog</td>
<td>Combiner A = LUT (X, D0..D3), Combiner B = MAX (X, Y)</td>
</tr>
</tbody>
</table>

Although the LUT for Stream A takes in X and D0..D3, the output depends only on the digital bits.
Osiris Radar Input Connector

The Osiris input connector is a 0.050” pitch MDR receptacle.

Table 2: Osiris radar input connector pinout

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Radar (H1)</td>
<td>Radar1</td>
</tr>
<tr>
<td>2</td>
<td>DIG1(H)</td>
<td>DIG1</td>
</tr>
<tr>
<td>3</td>
<td>Sync1(H)</td>
<td>Sync1</td>
</tr>
<tr>
<td>4</td>
<td>DIG1(L)</td>
<td>Gnd/Dig9</td>
</tr>
<tr>
<td>5</td>
<td>Radar2(H)</td>
<td>Radar2</td>
</tr>
<tr>
<td>6</td>
<td>DIG3(H)</td>
<td>Dig3</td>
</tr>
<tr>
<td>7</td>
<td>Sync2(H)</td>
<td>Sync2</td>
</tr>
<tr>
<td>8</td>
<td>DIG3(L)</td>
<td>Gnd/Dig11</td>
</tr>
<tr>
<td>9</td>
<td>ARP1(H)</td>
<td>ARP1</td>
</tr>
<tr>
<td>10</td>
<td>CLK1(H)</td>
<td>CLK1</td>
</tr>
<tr>
<td>11</td>
<td>ACP1(H)</td>
<td>ACP1</td>
</tr>
<tr>
<td>12</td>
<td>DIG5(H)</td>
<td>DIG5</td>
</tr>
<tr>
<td>13</td>
<td>CLK2(H)</td>
<td>CLK2</td>
</tr>
<tr>
<td>14</td>
<td>DIG5(L)</td>
<td>Gnd/Dig13</td>
</tr>
<tr>
<td>15</td>
<td>ARP2(H)</td>
<td>ARP2</td>
</tr>
<tr>
<td>16</td>
<td>DIG7(H)</td>
<td>Dig7</td>
</tr>
<tr>
<td>17</td>
<td>ACP2(H)</td>
<td>ACP2</td>
</tr>
<tr>
<td>18</td>
<td>DIG7(L)</td>
<td>Gnd/Dig15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>DIG2(H)</td>
<td>Dig2</td>
</tr>
<tr>
<td>20</td>
<td>Radar1(L)</td>
<td>Gnd</td>
</tr>
<tr>
<td>21</td>
<td>DIG2(L)</td>
<td>Gnd/Dig10</td>
</tr>
<tr>
<td>22</td>
<td>Sync1(L)</td>
<td>Gnd</td>
</tr>
<tr>
<td>23</td>
<td>DIG4(H)</td>
<td>Dig4</td>
</tr>
<tr>
<td>24</td>
<td>Radar2(L)</td>
<td>Gnd</td>
</tr>
<tr>
<td>25</td>
<td>DIG4(L)</td>
<td>Gnd/Dig12</td>
</tr>
<tr>
<td>26</td>
<td>Sync2(L)</td>
<td>Gnd</td>
</tr>
<tr>
<td>27</td>
<td>ARP1(L)</td>
<td>Gnd</td>
</tr>
<tr>
<td>28</td>
<td>CLK1(L)</td>
<td>Gnd</td>
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<tr>
<td>29</td>
<td>DIG6(H)</td>
<td>Dig6</td>
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<td>30</td>
<td>ACP1(L)</td>
<td>Gnd</td>
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<tr>
<td>31</td>
<td>DIG6(L)</td>
<td>Gnd/Dig14</td>
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<tr>
<td>32</td>
<td>CLK2(L)</td>
<td>Gnd</td>
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<tr>
<td>33</td>
<td>DIG8(H)</td>
<td>Dig8</td>
</tr>
<tr>
<td>34</td>
<td>ARP2(L)</td>
<td>Gnd</td>
</tr>
<tr>
<td>35</td>
<td>DIG8(L)</td>
<td>Gnd/Dig16</td>
</tr>
<tr>
<td>36</td>
<td>ACP2(L)</td>
<td>Gnd</td>
</tr>
</tbody>
</table>

Osiris with RVP

Osiris is compatible with Curtiss-Wright’s RVP product, which provides a capability for radar video distribution over LAN, plot extraction, target tracking and video recording. A single Osiris card can support the processing of dual-independent channels of radar video, which can be distributed to multiple display clients using RVP. A typical installation will feature RVP running on a VME or CompactPCI (cPCI) single board computer (SBC), with an Osiris PMC board serving as the radar interface. Alternatively, RVP can run on a PCI-based system with Osiris-PCI providing the radar input.

Osiris Board Support Software

Osiris has a device driver and board support package that provides a C language programming interface to application developers. This board support library provides a well-documented interface to all functions of the board, including configuration and data transfers.

Specifications

**Functional**

- Digitisation and processing of radar video
- Up to 16 k samples per return
- Maximum output rate 50 MB/s per channel
- Internal test pattern generator
- Gain-and-offset-with-range compensation
- Time-stamped radar returns
- Onboard FPGA for processing
- Sample frequency up to 50 MHz
- Range and inter-return processing by highest-wins or lowest-wins

**Radar Video Inputs**

- Two Analog video inputs (two active selected from four inputs for Osiris B):
  - Differential, single-ended or high impedance
  - -1.5 V to +6.5 V range
  - 50 MHz sampling, 25 MHz bandwidth with programmable digital filtering
  - Eight digital inputs, RS-422 or RS-423
  - Clock input (optional)
  - 75 Ohms termination (single-ended), 120 Ohms (differential), 1k Ohms (high impedance)
  - ESD protection to 6.5KV

**Dual-sync (Trigger) Input**

- Programmable delay from trigger to range zero
- Differential, single-ended or high impedance
- 75 Ohms termination (single-ended), 120 Ohms (differential), 1k Ohms (high impedance)
- 0 to +30V input (maximum power dissipation is 0.5 W on PMC card and 10 W on PCI card. For high-voltage sync inputs an external high-power terminating resistor may be required).
Turning Data

- ACP/ARP
- ACP count: up to 16384.
- Differential, single-ended or high impedance
- 75 Ohms termination (single-ended), 120 Ohms (differential), 1k Ohms (high impedance)
- Minimum pulse width is 100 ns
- RADDs I and II formats (MIL-STD-751B)
- Synchro input supported on PCI variant of card with addition of synchro-adaption module
- For AN/UYQ-21, AN/UYA-4 and other serial and parallel formats, consult factory for further information

Radar Data Output

- PCI interface to host processor
- 64-bit, 66 MHz PCI interface (32-bit interface on PCI version of card)

Connectors

- 36 way MDR socket for all radar video, trigger and azimuth signals.
- Synchro input on PCI version of card from flying lead to separate connector.

Software, O/S and Host Support

- Compatible with RVP for radar network distribution and target tracking
- Board support library available:
  - Windows®
  - Linux®/x86

Physical & Mechanical

- Available as single PMC or half-length PCI module
- PMC version:
  - Dimensions: 74 x 155 mm IEEE P1386.1
  - Weight: 100 g
- PCI version
  - Dimensions: 174 x 106 mm
  - Weight: 100 g

Electrical

- Power Consumption:
  - +3.3 V 700 mA
  - +5 V 200 mA
  - +12 V 30 mA
  - -12 V 80 mA
- Standard PCI v2.2 interface (33 or 66 MHz, 3.3 V or 5 V signaling)

Environmental

Available in the following Curtiss-Wright environmental grades:

- Air-cooled Level 0
  - Operating temperature 0 to +50°C
  - Storage temperature -40 to +85°C
- Air-cooled Level 50 (conformally coated)
  - Operating temperature -20 to +65°C
  - Storage temperature -40 to +85°C

For further details please see the Curtiss-Wright Ruggedization Table at http://www.cwembedded.com/ruggedization
Table 3: Configuration Options and Part Numbers

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPCI-C616-0-0000</td>
<td>Osiris PCI Radar Interface card: Air-cooled, Level 0 specification.</td>
</tr>
<tr>
<td>SPCI-C616-0-0001</td>
<td>Osiris PCI Radar Interface card: Parallel azimuth version Air-cooled, Level 0 specification.</td>
</tr>
<tr>
<td>SPCI-C616-0-C000</td>
<td>Osiris PCI Radar Interface card: Air-cooled, Level 50 specification. Conformally coated</td>
</tr>
<tr>
<td>SPMC-C617-0-0000</td>
<td>Osiris PMC Radar Interface card: Air-cooled, Level 0 specification.</td>
</tr>
<tr>
<td>SPMC-C617-5-C000</td>
<td>Osiris PMC Radar Interface card: Air-cooled, Level 50 specification. Conformally coated</td>
</tr>
<tr>
<td>SPMC-C660-0-0000</td>
<td>Osiris-B PMC Radar Interface card: Four radar inputs Air-cooled, Level 0 specification.</td>
</tr>
<tr>
<td>DSW-C580-0-0401</td>
<td>Osiris board support library and driver for Windows and Linux/x86</td>
</tr>
<tr>
<td>CBL-C617-0-0500</td>
<td>Breakout cable from Osiris front-panel connector to 25-way D connector (for digital radar inputs) and 8x BNC (trigger, video, ACP and ARP for each of two channels). Length 1.2m.</td>
</tr>
<tr>
<td>SPCI-C616-0-020x</td>
<td>Osiris PCI Radar Interface card with synchro interface; consult factory for options</td>
</tr>
</tbody>
</table>

Warranty
This product has a one year warranty.

Contact Information
To find your appropriate sales representative:
Website: [www.cwcembedded.com/sales](http://www.cwcembedded.com/sales)
Email: sales@cwcembedded.com

Technical Support
For technical support:
Website: [www.cwcembedded.com/support1](http://www.cwcembedded.com/support1)
Email: support1@cwcembedded.com

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