GaGe wideband downconverters are wide frequency coverage receivers that feature a single RF input and 3 standard software selectable IF bandwidths, from 10 MHz to 100 MHz, or 3 optional software selectable IF bandwidths, from 10 MHz to 160 MHz. The carrier center frequencies can be tuned from 50 MHz to 27 GHz, using direct digitization below 50 MHz.

Full control and data acquisition support are provided via Mathworks’ MATLAB, with example programs furnished to facilitate rapid signal processing and modulation analysis program development. Additional software includes a Spectrum Analyzer program, SpectraScopeRT, and SDK and example programs for C/C# and LabVIEW.

**APPLICATIONS**

Communications R&D  
Communications Manufacturing Test  
Wireless Network Testing/Management  
Wideband Test & Measurement  
Spectrum Analysis  
Government Spectrum Licensing and Monitoring  
Military Signal Intelligence (COMINT/SIGINT)  
Wideband Stimulus / Response Testing  
Radar Design and Test  
Medical Research

**FEATURES**

- 100 kHz – 27 GHz Frequency Coverage  
- 3 Standard Selectable IF Bandwidths – 100 MHz, 40 MHz, 10 MHz  
- 3 Optional Selectable IF Bandwidths – 160 MHz, 80 MHz, 10 MHz  
- 8, 20, or 24-Channel Switched Pre-Select Filter Bank and Pre-Amplifier  
- Digitizer Resolution Options: 12-Bit, 3 GS/s or 16-bit, 200 MS/s  
- Real-Time Data Capture to Digitizer Memory – up to 8 GB or 16 GB  
- Real-Time Data Capture to Data Storage System – up to 192 TB  
- Real-Time No Programming Spectrum Analyzer App – SpectraScopeRT  
- MATLAB Support for Control, Acquisition, and Signal Processing  
- Sustained Gap-Free PCIe Streaming to PC Memory up to 4.0 GB/s  
- Multi-Channel Systems with 10 MHz In/Out Synchronization  
- Software Development Kits Available for C/C#, LabVIEW and MATLAB
GaGe Wideband Downconverters – Main Specifications

<table>
<thead>
<tr>
<th>Downconverter Model</th>
<th>Frequency Coverage</th>
<th>Standard Bandwidth</th>
<th>Optional Bandwidth</th>
<th>Pre-Select Filter Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC8G100</td>
<td>100 kHz – 8 GHz</td>
<td>100 MHz (0 Hz IF), 40 MHz / 10 MHz (35 MHz IF)</td>
<td>160 MHz (0 Hz IF), 80 MHz (55 MHz IF), 10 MHz (35 MHz IF)</td>
<td>8-Channel Switched</td>
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<tr>
<td>DC18G100</td>
<td>100 kHz – 18 GHz</td>
<td>100 MHz (0 Hz IF), 40 MHz / 10 MHz (35 MHz IF)</td>
<td>160 MHz (0 Hz IF), 80 MHz (55 MHz IF), 10 MHz (35 MHz IF)</td>
<td>20-Channel Switched</td>
</tr>
<tr>
<td>DC27G100</td>
<td>100 kHz – 27 GHz</td>
<td>100 MHz (0 Hz IF), 40 MHz / 10 MHz (35 MHz IF)</td>
<td>160 MHz (0 Hz IF), 80 MHz (55 MHz IF), 10 MHz (35 MHz IF)</td>
<td>24-Channel Switched</td>
</tr>
</tbody>
</table>

These downconverter models, featuring breakthrough frequency and bandwidth coverage for their size and cost, are available with 3 standard or 3 optional bandwidths, covering three frequency ranges from 100 kHz to 8 GHz, 18 GHz, or 27 GHz.

The downconverters feature bandwidths of 100 MHz (standard) or 160 MHz (optional) direct conversion (0 Hz IF) I and Q analog outputs. These wideband versions can be software configured for super heterodyne mode with a bandwidth of either 40 MHz or 10 MHz (standard) on a single IF output centered at 35 MHz IF, or with a bandwidth of either 80 MHz (optional) on a single IF output centered at 55 MHz IF.

These wideband products are engineered for analyzing wideband digital communications - cell phone standards 3G/4G/LTE, WiFi, or general Vector Signal Analysis (VSA) applications involving broadband signals.

The Downconverter RF front end is a unique architecture, consisting of both super-heterodyne and direct conversion technologies that are software selectable.

The front-end processing blocks utilize up to 24 pre-select filters to mitigate input-related spurs and image responses. The block diagram for the DC27G100 RF front end is shown below.

DC27G100 Block Diagram
### Operating Bandwidth Description

<table>
<thead>
<tr>
<th>Operating Bandwidth</th>
<th>Operating Bandwidth Description</th>
<th>Operating Bandwidth Figures</th>
</tr>
</thead>
</table>
| 100 MHz (Standard)  | In the widest bandwidth mode of operation the downconverter is configured as a direct-conversion receiver. This mode is well suited for applications such as ISM band signal analysis, LTE signal processing and RF data acquisition. Direct conversion receivers require IQ offsets to be corrected in user developed spectrum analysis software. Programming examples are included in the SDK manual. | ![100 MHz](image)

| 40 MHz (Standard)   | The downconverters super-heterodyne mode of operation allows for the processing of signals with bandwidths of up to 40 MHz or 80 MHz. This mode of operation is best suited for signal demodulation and spectrum analysis. The 40 MHz downconverted signals is centered at 35 MHz, and the 80 MHz downconverted signals is centered at 55 MHz. | ![40 MHz](image) |

| 10 MHz (Standard)   | The downconverters has a narrower 10 MHz super-heterodyne mode of operation. The narrower bandwidth filter centered at 35 MHz offers better rejection of adjacent signals.                                        | ![10 MHz](image) |

### Application Type and Recommended Bandwidth Settings

<table>
<thead>
<tr>
<th>Application Type and Recommended Bandwidth Settings</th>
<th>160 MHz</th>
<th>100 MHz</th>
<th>80 MHz</th>
<th>40 MHz</th>
<th>10 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demodulation of wideband signals such as LTE and Wi-Fi in the lab and field</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal demodulation</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal demodulation of video &amp; audio signals in an interference environment</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spectrum analysis</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RF measurements of signal amplitude, IP3, etc.</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detecting weak signals</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Fast, low-latency spectrum scanning</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>
The Downconverter models, when combined with GaGe High Speed Digitizers, allow for complete real-time signal recording and analysis systems covering frequencies up to 27 GHz. These solutions greatly extend the digitizer’s frequency range, and allow those developing applications in R&D, Manufacturing Test, and Field Service high performance, lower cost platforms for complex wideband RF and microwave signal analysis.

Downconverter standard bandwidth modes of 100 MHz, 40 MHz, and 10 MHz are ideally suited for use with the GaGe Razor Express PCIe Digitizer that features 16-bit resolution sampling up to 200 MS/s, along with up to 16 GB of onboard memory for real-time gap free signal recording at 100 MHz bandwidth.

Downconverter upgrade bandwidth modes of 160 MHz, 80 MHz, and 10 MHz are ideally suited for use with the GaGe EON Express PCIe Digitizer that features 12-bit resolution sampling up to 3 GS/s, along with up to 8 GB of onboard memory for real-time gap free signal recording at 160 MHz bandwidth.

The large FIFO memory of the GaGe digitizers also allow for real-time streaming of I and Q baseband signals at 2.0 GB/s (Razor Express) or 4.0 GB/s (EON Express) over PCI Express to PC memory for post processing, display, and storage.

The 4 channel Razor Express CSE1642 digitizer supports two downconverters and the 2 channel EON Express CSE123G2 supports one downconverter. 10 MHz reference inputs and outputs on both the GaGe digitizers and downconverter units provide a single frequency reference for synchronized system performance.

The Digitizers and Downconverters have full control and data acquisition support via Mathworks MATLAB, with example programs furnished to facilitate rapid signal processing and modulation analysis program development. Additional software SDK and example programs are available for C/C# and LabVIEW.

For manual control, testing and setup of the Ethernet connected Downconverters, programs are provided for network discovery, setting carrier frequency, RF / IF gain, filters, etc.

Frequency domain signal analysis of the Downconverter baseband output signals is done with the DynamicSignals Spectrum Analyzer program, SpectraScopeRT, supporting integrated digitizer and downconverter control, zoom amplitude and frequency display, cursors, and waveform signal storage/printing.
SpectraScopeRT – Real-Time Spectrum Analyzer Software

The provided real-time Spectrum Analyzer program, SpectraScopeRT, requires no programming and allows for the control of receiver center frequency and bandwidth, plus digitizer selection and functions. This program also features various X,Y display scale viewing options, multiple cursors, averaging, printing, save/recall of setups, and many other useful features for Spectrum Analyzer type functionality.

SpectraScopeRT showing:

- IQ Time Domain
- I Spectrum
- IQ Offset Corrected 100 MHz Power Spectrum

SpectraScopeRT showing:

- A typical WiFi signal using peak hold (red trace) in superheterodyne mode
Downconverter Specifications

Tuning and Bandwidth
- Frequency Range: 100 kHz to 8 GHz, 18 GHz, or 27 GHz
- Tuning Resolution with Analog IF Outputs: 100 kHz
- Standard Max. Instantaneous Bandwidth (software selectable): 10 MHz, 40 MHz, 100 MHz
- Optional Max. Instantaneous Bandwidth (software selectable): 10 MHz, 80 MHz, 160 MHz

Spurious Free Dynamic Range (SFDR)
- @ 100 MHz Bandwidth: ≥ 60 dBc (nominal)
- @ 10 / 40 MHz Bandwidth: ≥ 70 dBc (nominal)

Frequency Reference
- Internal/External: 10 MHz
- Internal 10 MHz Oscillator Stability: ±1 ppm
- Phase Coherence: Multi-channel synchronization can be achieved by ordering the external local oscillator inputs option.

Amplitude
- Accuracy from 100 kHz to 3 GHz, at 25 °C ± 5 °C: ± 2.00 dB typical
- Accuracy from >3 GHz to 8 GHz, at 25 °C ± 5 °C: ± 2.75 dB typical
- Measurement Range: DANL to max. safe input level
- Attenuator Range – 8 GHz Model (N/A on 18 or 27 GHz Models): 0 or 20 dB
- Max. Safe RF Input Level: +10 dBm

RF PLL Phase Noise at 1 GHz (using internal 10 MHz reference)
<table>
<thead>
<tr>
<th>Frequency Offset</th>
<th>1 kHz</th>
<th>10 kHz</th>
<th>100 kHz</th>
<th>1 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF PLL Phase Noise (dBc/Hz) Typical</td>
<td>-90</td>
<td>-105</td>
<td>-115</td>
<td>-143</td>
</tr>
</tbody>
</table>

Displayed Average Noise Level (DANL)

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Without Pre-Amp at 25 °C ± 5 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 MHz</td>
<td>-151 dBm/Hz typical</td>
</tr>
<tr>
<td>500 MHz</td>
<td>-151 dBm/Hz typical</td>
</tr>
<tr>
<td>1 GHz</td>
<td>-150 dBm/Hz typical</td>
</tr>
<tr>
<td>2 GHz</td>
<td>-149 dBm/Hz typical</td>
</tr>
<tr>
<td>3 GHz</td>
<td>-145 dBm/Hz typical</td>
</tr>
<tr>
<td>4 GHz</td>
<td>-140 dBm/Hz typical</td>
</tr>
<tr>
<td>5 GHz</td>
<td>-142 dBm/Hz typical</td>
</tr>
<tr>
<td>6 GHz</td>
<td>-134 dBm/Hz typical</td>
</tr>
<tr>
<td>7 GHz</td>
<td>-134 dBm/Hz typical</td>
</tr>
<tr>
<td>8 GHz</td>
<td>-131 dBm/Hz typical</td>
</tr>
</tbody>
</table>

Third Order Intercept (TOI)
- At 1 GHz: +12 dBm, typical

Gain Control
- Front-End Attenuator (software selectable): 20 dB – 8 GHz model only (N/A for 18 or 27 GHz models)

Pre-Selection Filter Bank
- 8 GHz Model – DC8G100: 8-channel switched
- 18 GHz Model – DC18G100: 20-channel switched
- 27 GHz Model – DC27G100: 24-channel switched

Panel Connectors
- RF Antenna Input: SMA female, 50 Ω
- 10 MHz Reference In & Out: SMA female, 50 Ω
- Analog I and Q Out: SMA female, 50 Ω
- 10/100/1000 Ethernet: RJ-45
- USB 2.0 Console: Mini-USB
- GPIO: 25-pin Male D-Subminiature
- Coaxial Power: Type A: 5.5 mm OD, 2.5 mm ID

Physical
- Power Supply: +12 V DC
- Power Consumption: 18 W
- Operating Temperature Range: 0°C to +50°C / 32° to 122° F
- Storage Temperature Range: -40°C to +85°C / -40° to 185° F
- Enclosure Dimensions: 269 (L) x 173 (W) x 55 (H) mm

Regulatory Compliance
- RoHS Compliance: RoHS/RoHS 2
- Marks: CE European Union
- Low Voltage Directive 2006/95/EC: EN 61010-1:2010 Class 1
- Safety
ORDERING INFORMATION

Hardware

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Frequency Coverage</th>
<th>Standard Bandwidth</th>
<th>Pre-Select Filter Bank</th>
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<td>DSD-18G-100</td>
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</tr>
</tbody>
</table>

All downconverter models include: power supply, ISM antenna, Ethernet cable, and USB cable

Bandwidth Configuration Upgrade

Can be ordered with any of the above downconverter models. Replaces the standard bandwidth for the optional bandwidth configuration as follows:

- 160 MHz (0 Hz IF), 80 MHz (55 MHz IF), 10 MHz (35 MHz IF)

NOTE: This bandwidth configuration upgrade requires the selection of the GaGe 12-bit, 3 GS/s EON Express Digitizer or the Signatec 14-bit, 400 MS/s PXI14400D2 Digitizer to be paired with the downconverter unit.

DSD-BWC-160

External Local Oscillator Input Upgrade

Radio receiver front-end support for external local oscillator input for direction finding and multi-channel applications.

DSD-ELO-100

Accessory Options

- 19” rackmount shelf that supports two horizontally mounted or six vertically mounted (require separate vertical mounting kit) downconverter units.
  DSD-RCK-100
- Vertical mounting kit for 19” rackmount shelf. Kit contains six vertical mounts including fasteners. Does not include the rackmount shelf.
  DSD-VMT-100
- Wall mount bracket for a single downconverter unit, includes fasteners.
  DSD-WBK-100
- 20,000 mAh 12V battery
  DSD-BAT-100

Software

- SpectraScopeRT – Real-Time Spectrum Analyzer Software
  Included
- Downconverter Software APIs for C/C++, MATLAB, and LabVIEW
  Included

WARRANTY

Standard one year parts and labor.

Unless otherwise specified, all dynamic performance specs have been qualified on engineering units. All specifications subject to change without notice.

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