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FIBER OPTIC  
SOLUTIONS TO 100 GBPS



■ 40G / 100G Long-Haul and Metro Networks ■ 100G Optical Ethernet Solutions ■ 32G Fiber Channel, Infiniband-EDR ■ 100G Active Optical & Copper Cables ■ Network & Storage Systems ■ Timing and Frequency Generation ■ Broadband Test & Measurement

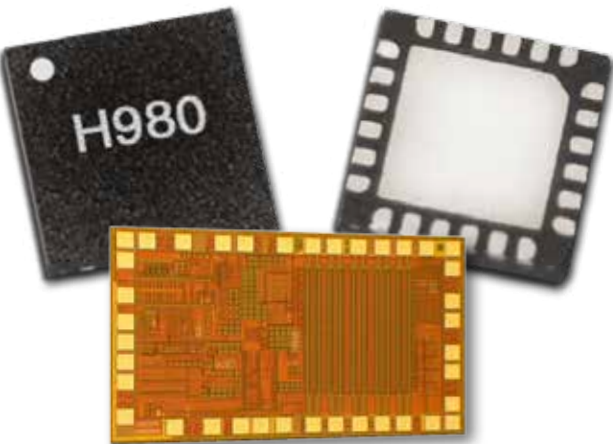
# FIBER OPTIC COMMUNICATIONS

Having built a strong reputation for technical innovation and product quality, **Hittite Microwave** has developed a broad portfolio of fiber optic and networking products. Our products meet the demanding requirements of high-speed communication and test applications.

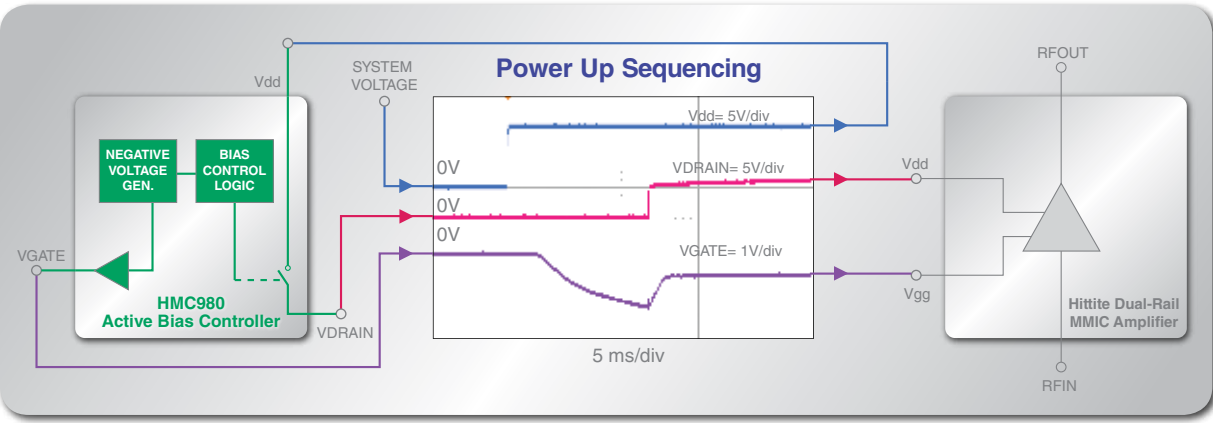
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# ACTIVE BIAS CONTROLLER



- HMC980**  
**High Current, Accepts +5.0 to +16.5V Supply Range**
- Automatic gate voltage adjustment – *No calibration required*
  - Ideal for both enhancement and depletion mode devices
  - Able to sink or source up to 4 mA of gate current
  - Internal negative voltage generation
  - Over/Under current alarm with built-in hysteresis



| Part Number | Supply Range (V) | Function               | VDRAIN Range (V) | IDRAIN Bias Current (mA) | IGATE Drive Current (mA) | VGATE Range (V) | Over/Under IDRAIN Current Alarm | Package |
|-------------|------------------|------------------------|------------------|--------------------------|--------------------------|-----------------|---------------------------------|---------|
| HMC920LP5E  | 5 to 16.5        | Active Bias Controller | 3 to 15          | 0 to 500                 | -4 to 4                  | -2.5 to 2.5     | Yes                             | LP5     |
| HMC980      | 5 - 16.5         | Active Bias Controller | 5 - 16.5         | 50 - 1600                | -4 to +4                 | -2.46 to +2.04  | Yes                             | Chip    |
| HMC980LP4E  | 5 to 16.5        | Active Bias Controller | 5 to 16.5        | 50 to 1600               | -4 to 4                  | -2.46 to +2.04  | Yes                             | LP4     |
| HMC981      | 4 to 12          | Active Bias Controller | 4 to 12          | 20 to 200                | -0.8 to +0.8             | -2.5 to +2.0    | –                               | Chip    |
| HMC981LP3E  | 4 to 12          | Active Bias Controller | 4 to 12          | 0 to 200                 | -0.8 to +0.8             | -2.5 to +2.5    | –                               | LP3E    |

**Optical Driver Amplifiers that benefit active bias controllers**

|           |         |           |              |
|-----------|---------|-----------|--------------|
| HMC870LC5 | HMC1051 | HMC5850BG | HMC7150LP3DE |
| HMC871LC5 | HMC1068 | HMC6282A  | HMC7282B     |
| HMC1050   | HMC1069 |           |              |

**Ideal for power management and control in all  
RF, Microwave, Millimeterwave, and Fiber Optic applications**

# ACTIVE BIAS CONTROLLER

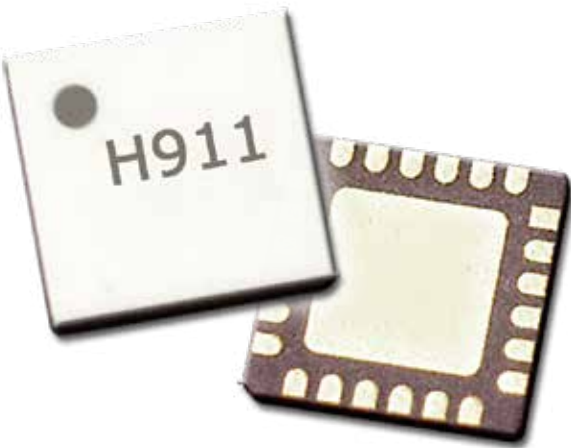
The **HMC980** is a High Current, Active Bias Controller die which is ideal for amplifier power management and control in cellular infrastructure, microwave and millimeterwave communications, fiber optic, consumer, military, space and test equipment applications.

Hittite's bias control solutions automatically adjust an amplifier's gate voltage to achieve a constant bias current over part-to-part and temperature variations. This auto-gate bias adjustment provides a significant advantage compared with discrete-based solutions since it eliminates manual calibration. Additionally, the HMC980 Active Bias Controller die offers a significant PCB area reduction by integrating negative voltage generator, automatic gate adjustment and power-up sequencing circuit blocks in a single monolithic device.

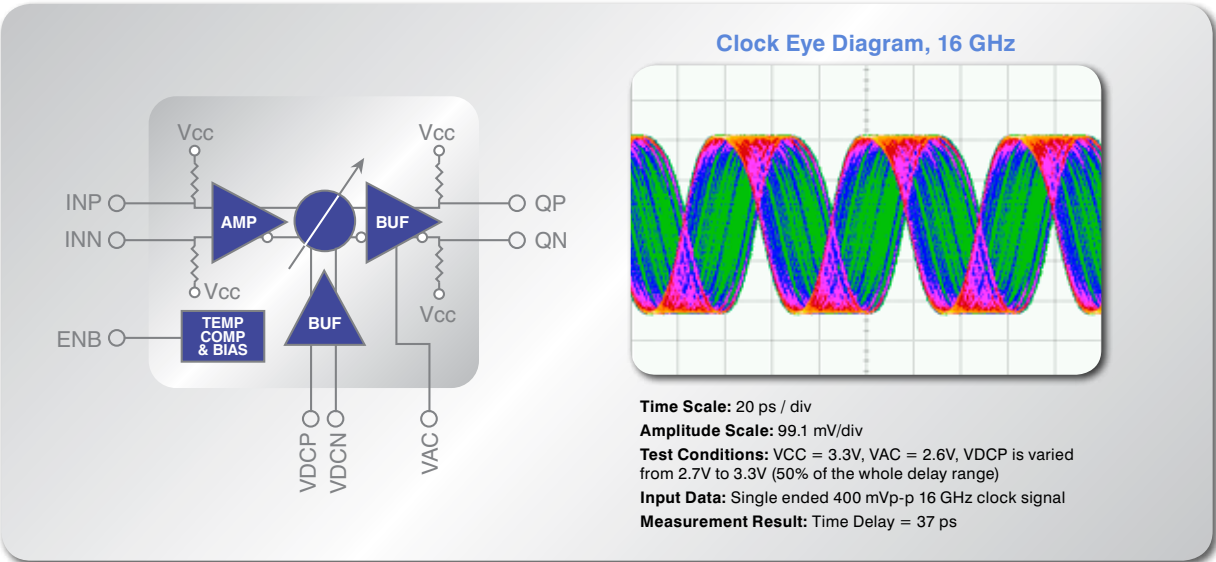
The HMC980 is designed to control amplifiers operating in Class A mode with bias currents up to 1.6A and supply voltages from 5V to 16.5V. The HMC980 Active Bias Controller die occupies less than 3.2 mm<sup>2</sup> of circuit area, requires a minimal number of external components, and incorporates an optional current alarm feature.

For applications which require a surface mount compatible solution, the HMC980 is also available in a 4 x 4 mm QFN plastic package as the HMC980LP4E. The HMC980 and the HMC980LP4E complement Hittite's line of DC Power Management solutions which operate with bias currents up to 2A and supplies from 3V to 16.5V.

# BROADBAND TIME DELAY



- HMC911LC4B**  
**Continuous Adjustable Delay Range: 70 ps**
- Single-ended or differential operation
  - Adjustable differential output voltage swing: up to 800 mVp-p
  - Delay control modulation BW: 1.6 GHz
  - Single supply: +3.3V



| Part Number | Data / Clock Rate (Gbps/GHz) | Function                          | Rise/Fall (ps) | Deterministic Jitter (ps) | Differential Output Voltage Swing (Vp-p) | DC Power Consumption (mW) | VCC Power Supply (Vdc) |
|-------------|------------------------------|-----------------------------------|----------------|---------------------------|------------------------------------------|---------------------------|------------------------|
| HMC877LC3   | 8 - 23                       | Analog Time Delay & Phase Shifter | 10 / 11        | 0.5 - 0.95                | —                                        | 627                       | +3.3                   |
| HMC910LC4B  | 32 / 24                      | Analog Time Delay                 | 14 / 14        | 6                         | 0.1 - 0.8                                | 1450                      | +3.3                   |
| HMC911LC4B  | 32 / 24                      | Analog Time Delay                 | 15 / 14        | 6                         | 0.8                                      | 1600                      | +3.3                   |
| HMC856LC5   | 28 / 28                      | Digital Time Delay                | 20 / 18        | <2                        | 0.5 - 1.35                               | 610                       | -3.3                   |

Ideal for Synchronization of Clock & Data, Transponder Design, Serial Data Transmission, Broadband Test & Measurement, and RF ATE applications

# BROADBAND TIME DELAY

The **HMC911LC4B** is a broadband time delay with 0 to 70 ps continuously adjustable delay range. The delay control is linearly monotonic with respect to the differential delay control voltage (VDCP, VDCN), and the control input has a modulation bandwidth of 1.6 GHz.

The device provides a differential output voltage with constant amplitude for single-ended or differential input voltages above the input sensitivity level, while the output voltage swing may be adjusted using the VAC control pin.

HMC911LC4B features internal temperature compensation and bias circuitry to minimize delay variations with temperature. Output pins can be connected directly to a 50 Ohm to VCC terminated system, while DC blocking capacitors must be used if the terminated system input is 50 Ohms to a DC voltage other than VCC.

The HMC911LC4B is available in RoHS-compliant 4 x 4 mm SMT package.

# CLOCK & TIMING ICs

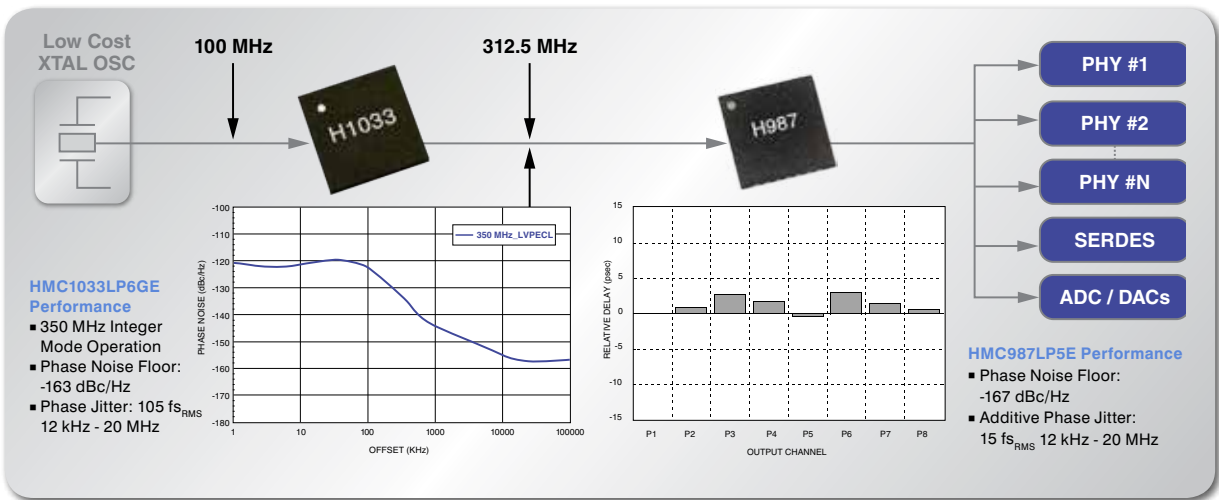


### HMC1033LP6GE / HMC1035LP6GE +3.3V Clock Generators

- <98 fs RMS jitter generation, -163 dBc/Hz phase noise floor
- 160 mA total power consumption
- “Phase Noise on Demand” feature to switch between “Power Priority” and “Performance Priority” modes
- “Exact Frequency Mode” achieves 0 Hz frequency error

### HMC987LP5E 1:9 Fanout Buffer, DC - 8 GHz

- Ultra low-noise floor: -167 dBc/Hz @ 622.08 MHz
- LVPECL, LVDS, CML and CMOS compatible inputs
- Ideal for ADC/DAC applications: 65 ps rise and fall time



### Clock Distribution

| Part Number | Max. Clock Rate (GHz) | Function                         | Phase Jitter (12 k - 20 MHz) | Rise/Fall Time (ps) | Channel Skew (ps)      | Power Supply (V) | Package |
|-------------|-----------------------|----------------------------------|------------------------------|---------------------|------------------------|------------------|---------|
| HMC987LP5E  | 8                     | 1:9 Fanout Buffer                | 8 fsRMS                      | 65                  | 3.1                    | 3.3              | LP5     |
| HMC988LP3E  | 4                     | Clock Divider & Delay Management | 13 fsRMS                     | 90                  | 300 - 1500 Prog. Delay | 5 or 3.3         | LP3     |

### Clock Generators

| Part Number  | Max. Freq. (MHz) | Function                       | Typ. Phase Jitter (fs <sub>RMS</sub> ) | Phase Noise Floor (dBc/Hz) | Max. Ref. Freq. (MHz) | Typ. Power Consump. (W) | Figure of Merit (Frac/Int) (dBc/Hz) | Package |
|--------------|------------------|--------------------------------|----------------------------------------|----------------------------|-----------------------|-------------------------|-------------------------------------|---------|
| HMC1031MS8E  | 500              | Integer Mode PLL (x1, x5, x10) | Defined by VCXO                        | Defined by VCXO            | 140                   | 0.005                   | -208                                | MS8E    |
| HMC1033LP6GE | 550              | Clock Generator, +3.3V         | 99                                     | -163                       | 350                   | 0.64                    | -226 / -227                         | LP6GE   |
| HMC1035LP6GE | 2500             | Clock Generator, +3.3V         | 97                                     | -163                       | 350                   | 0.57                    | -226 / -227                         | LP6GE   |

Ideal for Clocking ADC/DAC, SERDES, Physical Layer Devices (PHY) & FPGAs

# CLOCK & TIMING INTEGRATED CIRCUITS

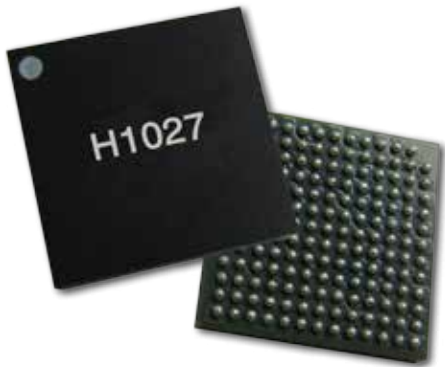
The **HMC1033LP6GE** is a low-noise, wide-band 3.3V clock generator IC with a fractional-N Phase Locked Loop (PLL) featuring an integrated Voltage Controlled Oscillator (VCO). The device provides differential clock outputs between 25 MHz and 550 MHz range. The low-noise Phase Detector (PD) and Delta-Sigma modulator is capable of operating at up to 100 MHz permitting wider loop-bandwidths and excellent spurious performance.

The **HMC1035LP6GE** is a low-noise, wide-band 3.3V clock generator IC, with a fractional-N Phase Locked Loop (PLL) featuring an integrated Voltage Controlled Oscillator (VCO). The device provides differential clock outputs between 25 MHz and 2500 MHz range. The low-noise Phase Detector (PD) and Delta-Sigma modulator is capable of operating at up to 100 MHz permitting wider loop-bandwidths and excellent spurious performance.

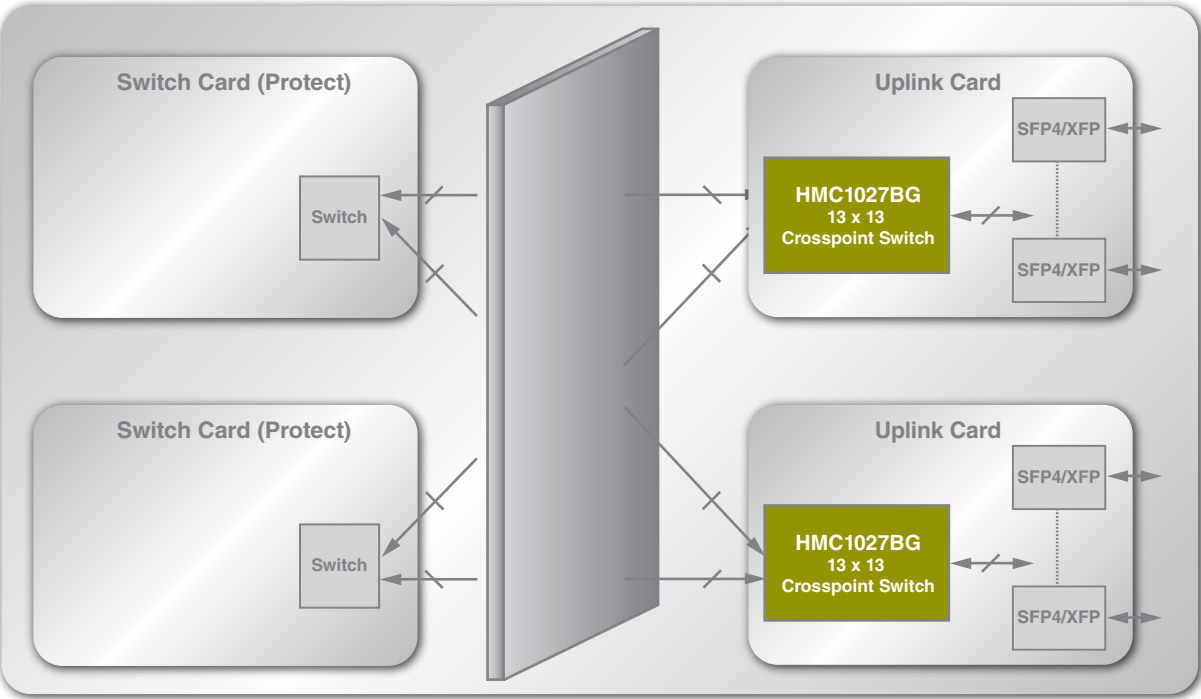
The **HMC987LP5E** 1-to-9 fanout buffer is designed for low-noise clock distribution. It is intended to generate relatively square wave outputs with rise/fall times <100 ps. The low skew and jitter outputs, combined with its fast rise/fall times, leads to controllable low-noise switching of downstream circuits such as mixers, ADCs/DACs, or SERDES devices. The noise floor is particularly important in these applications, when the clocknetwork bandwidth is wide enough to allow squarewave switching. Driven at 2 GHz, outputs have a noise floor of -166 dBc/Hz, corresponding to a jitter density of 0.6 asec/rHz – or 50 fs over an 8 GHz bandwidth.



# CROSSPOINT SWITCH



- HMC1027BG Features**
- Low Power Operation
    - <70 mW / channel in equalization bypass mode
    - <100 mW / channel in equalization enable mode
  - Single 2.5V supply operation with ability for I/O to operate at 1.8V
  - Independent input and output power down options of unused channels
  - Digital control via two-wire interface



| Part Number | Data Rate (Gb/s) | Function                  | Rise / Fall Time (ps) | Differential Output Swing (Vp-p) | DC Power Consumption/ Channel (mW) | DC Power Supply (Vdc) | Package |
|-------------|------------------|---------------------------|-----------------------|----------------------------------|------------------------------------|-----------------------|---------|
| HMC1027BG   | 14.2             | 13 x 13 Crosspoint Switch | 23 / 23               | 0.4 - 0.8                        | <100                               | 2.5V, 1.8V            | BGA     |
| HMC857LC5   | 14 / 14          | 2 x 2 Crosspoint Switch   | 21 / 21               | 0.5 - 1.2                        | 150                                | -3.3                  | LC5     |

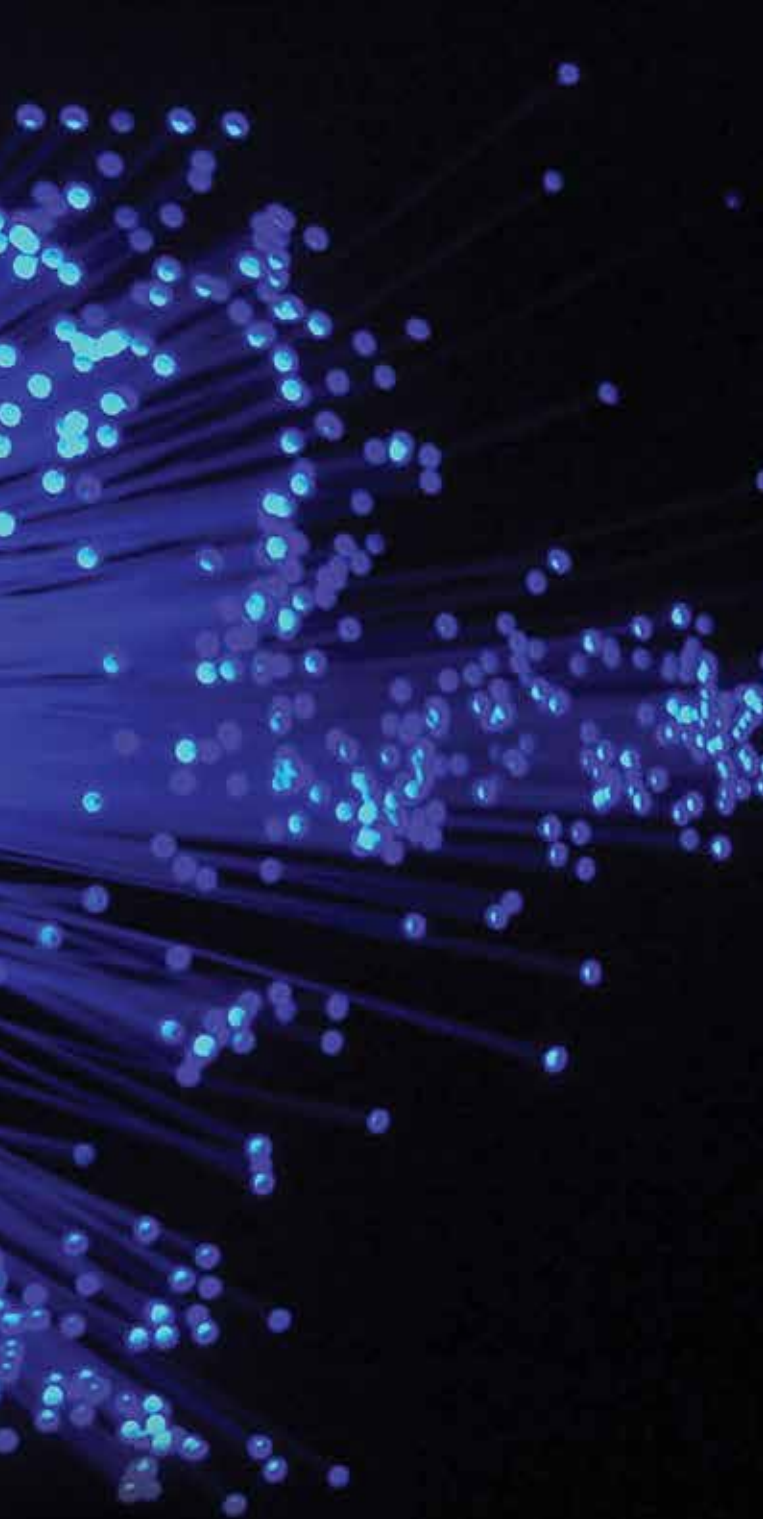
Low-Power, High Performance, Fully Programmable

# CROSSPOINT SWITCH

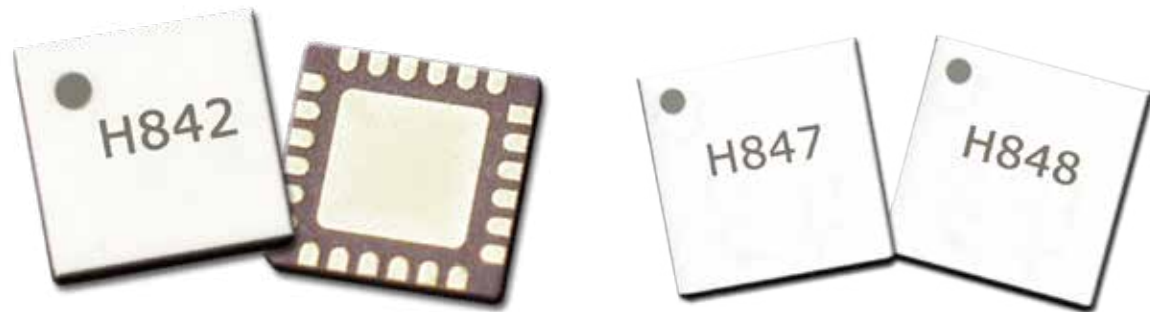
The **HMC1027BG** is an extremely low-power, high-performance, fully programmable asynchronous 13 x 13 crosspoint switch operating with data rates up to 14.2 Gbps. It consists of a programmable input equalizer, a 13 x 13 switch, and a de-emphasis based programmable output driver. The 13 x 13 switch is fully non-blocking and it allows any input to be routed to any output, any combination of outputs, or broadcast to all outputs. The HMC1027BG performs both receive equalization (EQ) and transmit de-emphasis (DE) on all input and output channels to compensate for signal impairments due to Inter-Symbol Interference (ISI) caused by a wide variety of transmission media and channel lengths. The input equalizer can be bypassed for short links to further reduce the overall power dissipation. The 13th channel is identical to the other 12 channels and it can be used either as the 13th channel, or used for signal injection and monitoring to aid debugging during the prototyping stage.

All high-speed differential inputs and outputs of the HMC1027BG are Current Mode Logic (CML) and terminated on-chip with 50 Ohms to the positive supply, 1.8V or 2.5V, and may be DC or AC coupled. The inputs and outputs of the HMC1027BG can be operated in either single-ended or differential modes.

The low-power, high-performance and feature-rich HMC1027BG is packaged in a 169 pin and 1 mm ball pitch, 14 x 14 mm BGA package. The device uses a 2.5V core supply but the I/O can be operated at 1.8V supply to reduce the power dissipation to less than 100 mW per channel. The HMC1027BG operates over a case temperature range of -40 °C to 85 °C.



# HIGH SPEED LOGIC ICs



## HMC842LC4 Fan-Out Buffer

- Supports Data / Clock Rates up to 45 Gbps / 28 GHz
- Fast Rise and Fall times: <12 ps
- Less than 500 fs Additive RMS Jitter
- Adjustable Differential Output Voltage Swing: 200 - 850 mVp-p

## HMC847LC5 & HMC848LC5

- Supports Data Rates up to 45 Gbps
- Single-ended or Differential Operation
- Half Rate Clock Input
- Quarter Rate Reference Clock Output
- Fast Rise and Fall times
- Low Power Consumption: <644 mW typical

| Part Number | Data / Clock Rate (Gbps / GHz) | Function              | Rise / Fall Time (ps) | Output Swing (Vp-p) | Package |
|-------------|--------------------------------|-----------------------|-----------------------|---------------------|---------|
| HMC720LP3E  | 13 / 13                        | 1:2 Fanout Buffer     | 19 / 18               | 0.6 - 1.1           | LP3     |
| HMC721LP3E  | 13 / 13                        | XOR / XNOR            | 19 / 18               | 0.6 - 1.2           | LP3     |
| HMC841LC4B  | 43 / 43                        | D-Type Flip-Flop      | 12 / 12               | 0.2 - 0.85          | LC4B    |
| HMC842LC4B  | 45 / 28                        | 1:2 Fanout Buffer     | 11 / 11               | 0.4 - 1.2           | LC4B    |
| HMC843LC4B  | 45 / 25                        | AND / NAND / OR / NOR | 10 / 10               | 0.2 - 0.9           | LC4B    |
| HMC844LC4B  | 45 / 25                        | XOR / XNOR            | 11 / 10               | 0.2 - 8.5           | LC3C    |
| HMC850LC3C  | 28 / 20                        | 1:2 Fanout Buffer     | 16 / 15               | 0.6 - 1.1           | LC3C    |
| HMC853LC3C  | 28 / 28                        | D-Type Flip-Flop      | 15 / 14               | 0.7 - 1.3           | LC3C    |
| HMC858LC4B  | 14 / 14                        | 2:1 Selector          | 19 / 20               | 0.5 - 1.3           | LC4B    |
| HMC958LC5   | 14 / 14                        | 4:1 Selector          | 17 / 17               | 0.5 - 1.3           | LC5     |
| HMC847LC5   | 45 / 22.5                      | 4:1 Mux               | 11 / 12               | 0.25 - 0.9          | LC5     |
| HMC848LC5   | 45 / 22.5                      | 1:4 Demux             | 25 / 21               | 0.3 - 1.0           | LC5     |
| HMC854LC5   | 28 / 14                        | 4:1 Mux               | 16 / 16               | 0.7 - 1.25          | LC5     |
| HMC855LC5   | 28 / 14                        | 1:4 Demux             | 22 / 22               | 0.45 - 1.14         | LC5     |

Ideal for High-Speed Interface Design and Broadband Test Applications

# HIGH SPEED LOGIC INTEGRATED CIRCUITS

The **HMC842LC4B** is a 1:2 Fanout Buffer designed to support data transmission rates up to 45 Gbps. The device can also operate with clock signals up to 28 GHz. During normal operation, input data (or clock) is transferred to both output channels. Differential input and output signals of the HMC842LC4B are terminated with 50 Ohms to ground on-chip, and may be either AC or DC coupled. The Outputs can be connected directly to a 50 Ohms-to-ground terminated system, while DC blocking capacitors should be used if the terminating system is 50 Ohms to a non-ground DC voltage.

The **HMC847LC5** is a 4:1 multiplexer designed for 45 Gbps data serialization. The mux latches the four differential inputs on the transition points of the input clock. The device uses both rising and falling edges of the half-rate clock to serialize the data. A quarter-rate clock output, which is synchronous to the data output of HMC847LC5, is generated on chip.

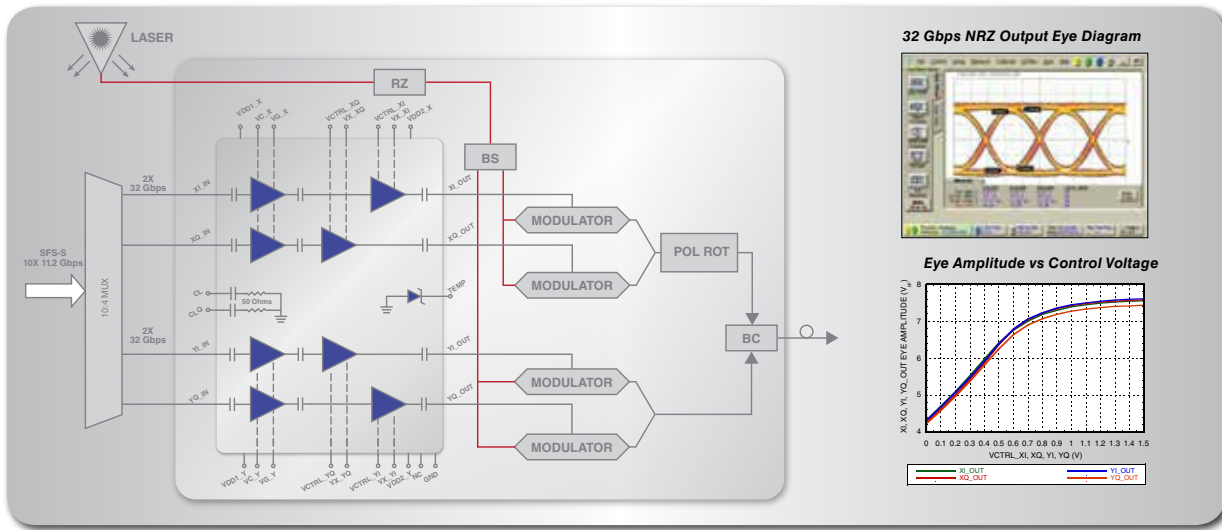
The **HMC848LC5** is a 1:4 demultiplexer designed for data deserialization up to 45 Gbps. The device uses both rising and falling edges of the half-rate clock to sample the input data in sequence, D0-D3 and latches the data onto the differential outputs. A quarter-rate clock output generated on-chip can be used to clock the data into other devices.



# OPTICAL MODULATOR DRIVER



- HMC7282B features:**
- 4.5W power dissipation for 6.5V output voltage
  - Less than 330 fs additive RMS jitter
  - Fully integrated compact module with GPPO interface
  - Hermetically-sealed module
  - Integrated temperature sensors
  - Module size: 40 x 25 x 6.5 mm



| Part Number | Data Rate (Gbps) | Function                                     | Gain (dB) | Group Delay Variation (ps) | Additive Jitter (ps) | Output Voltage Max. (Vp-p) | Package |
|-------------|------------------|----------------------------------------------|-----------|----------------------------|----------------------|----------------------------|---------|
| HMC7282B    | 32               | Quad Optical Modulator Driver                | 26        | ±3                         | 0.33                 | 7.4                        | Module  |
| HMC1068     | 32               | 32 Gbps Optical Modulator Driver, Pre-Stage  | 15        | ±5                         | 0.3                  | 3                          | Chip    |
| HMC1069     | 32               | 32 Gbps Optical Modulator Driver             | 15        | ±5                         | 0.3                  | 7.5                        | Chip    |
| HMC5850BG   | 32               | 8 Vp-p Optical Modulator Driver, SMT Package | 29        | ±7                         | 0.25                 | 8                          | BGA     |
| HMC6620BG   | 32               | Dual Channel Optical Modulator Driver        | 30        | ±4                         | 0.3                  | 8                          | BGA     |
| HMC6282A    | 28               | Quad Optical Modulator Driver                | 26        | ±4                         | 0.23                 | 7.5                        | Module  |

| Part Number  | Data Rate (Gbps) | Function           | Gain (dB) | Group Delay Variation (ps) | Additive Jitter (ps) | Output Voltage Max. (Vp-p) | Package |
|--------------|------------------|--------------------|-----------|----------------------------|----------------------|----------------------------|---------|
| HMC7150LP3DE | 28               | 28 Gbps EML Driver | 13        | ±7                         | 0.27                 | 2.2                        | LP3D    |

Ideal for Fiber Optics Transponders and Wideband Test & Measurement

# OPTICAL MODULATOR DRIVER

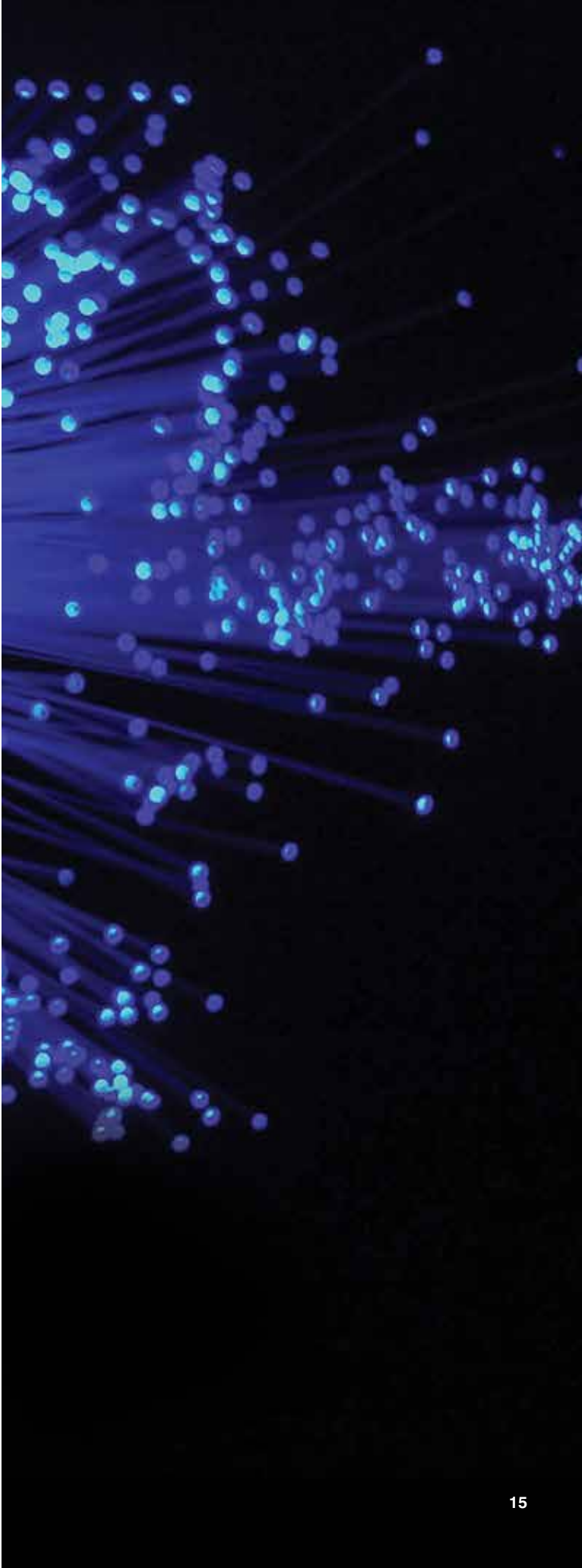
The **HMC7282B** is a four channel optical modulator driver amplifier module and is ideal for driving external mach-zender modulators in 100 Gbps DP-QPDK applications.

It is compliant with OIF's (Optical Interface Forum) "Integrated Polarization Multiplexed Quadrature Modulated Transmitters Implementation Agreement" and is hermetically sealed to meet stringent quality requirements of the fiber optic systems.

The device is a highly integrated connectorized module with 50 Ohm matched AC coupled RF inputs and outputs. The RF output ports are designed to withstand up to 50V DC bias voltages relative to the supply voltage in order to support varying modulator bias conditions. The supply and control voltage pins are equipped with internal de-coupling capacitors and a discrete isolated diode is incorporated in the module for temperature monitoring.

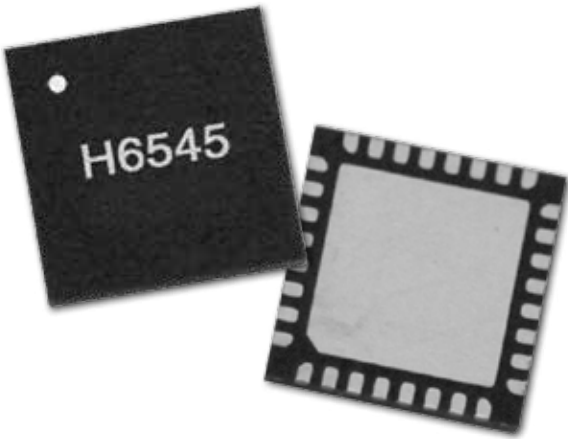
The HMC7282B can operate up to 32 Gbps and delivers up to 8 Vp-p output signal swing, exhibiting less than 0.25 psec additive jitter and ±5 psec group delay variation.

Operating on a wide supply range from 5V to 8V it features scalable power dissipation for varying output drive requirements. The HMC7282B consumes less than 4.5 W and 5.5 W, for 6.5 Vp-p and 7.5 Vp-p output voltage swing levels, respectively.

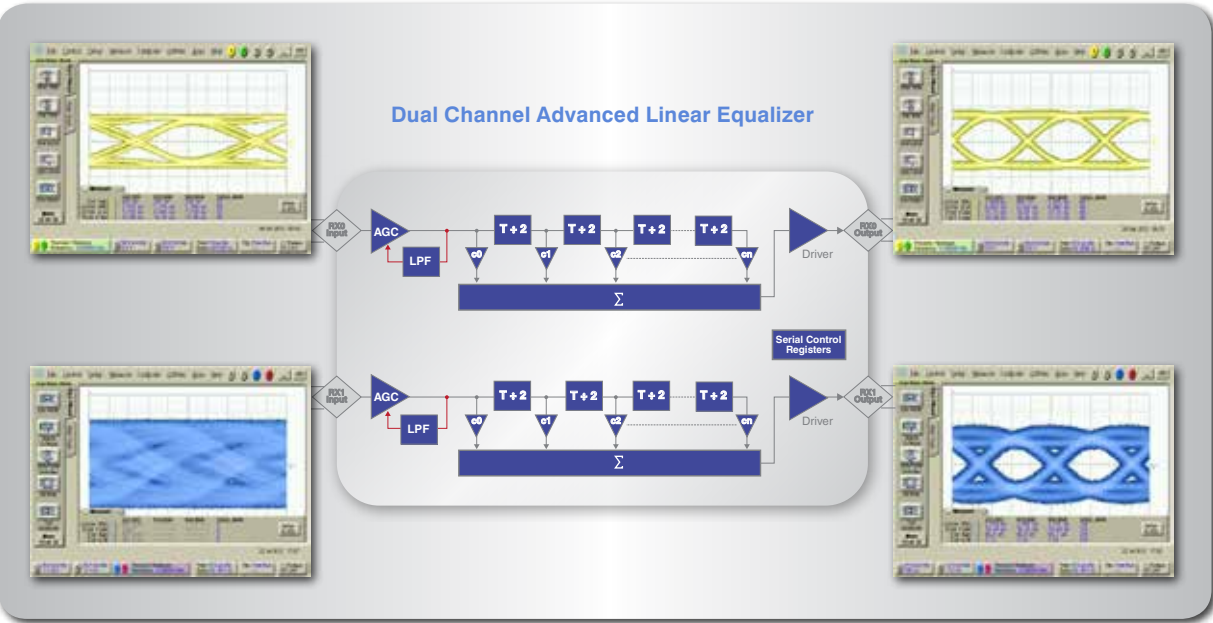




# SIGNAL CONDITIONER



- HMC6545LP5E applications:**
- 100 GbE line card and backplane
  - 16G / 32G fiber channel
  - 14G / 28G EDR infiniband
  - 10G / 100G stress eye generation
  - Broadband Test & Measurement
  - Active copper & optical cables
  - 6G / 12G SAS / SATA



| Part Number | Data Rate Max. (Gbps) | Function                  | Number of Taps | Input Sensitivity (mVp-p) | Tap Delay | Total Harmonic Distortion (%) | Package |
|-------------|-----------------------|---------------------------|----------------|---------------------------|-----------|-------------------------------|---------|
| HMC6545LP5E | 32                    | Advanced Linear Equalizer | 9              | 40                        | 18        | 5                             | LP5     |

Linear Programmable Equalizer for Backplane & Line Card Applications

# SIGNAL CONDITIONER

The **HMC6545LP5E** is a low-power, high-performance, fully programmable dual channel asynchronous advanced linear equalizer that operates with data rates up to 32 Gbps. It is protocol and data rate agnostic.

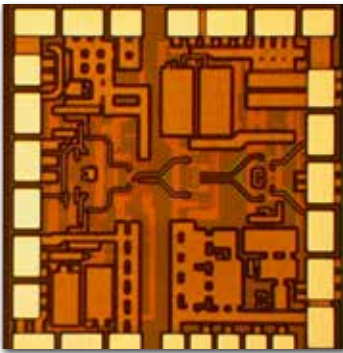
The device can operate on the transmit path to pre-distort transmitted signal in order to invert channel distortion, or on the receiver path to equalize the distorted and attenuated received signal.

HMC6545LP5E is effective in dealing with chromatic and polarization mode dispersion and Inter-Symbol Interference (ISI) caused by wide variety of transmission media, backplane and/or fiber, and channel lengths.

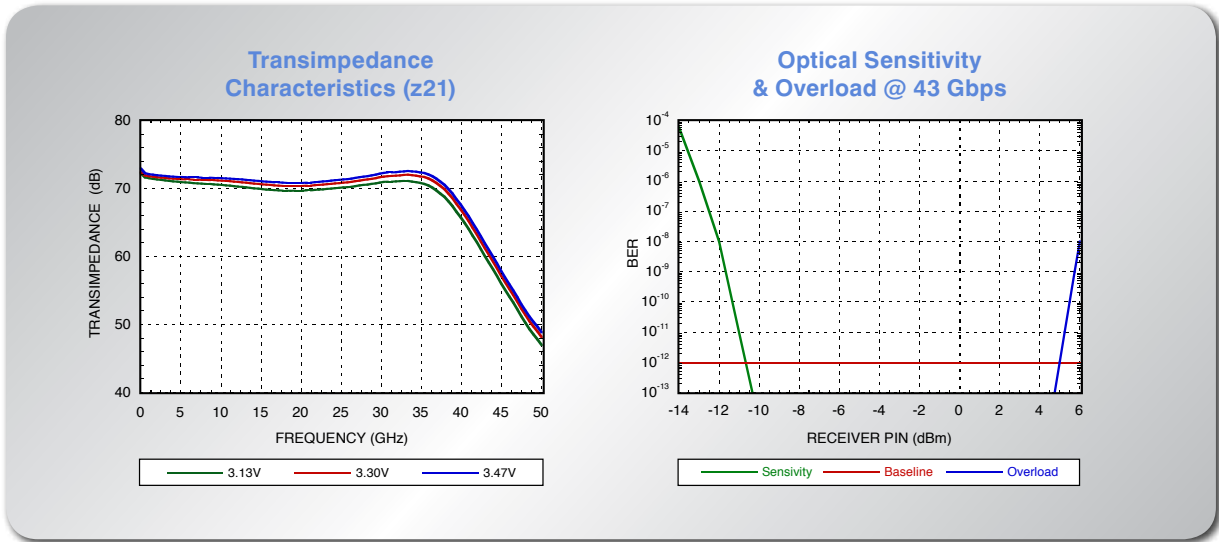




# TRANSIMPEDANCE AMPLIFIER



- HMC7590 features:**
- Supports data rates up to 43 Gbps
  - Internal DCA feedback with external adjustment option
  - 4 k $\Omega$  differential transimpedance gain
  - Low-power dissipation <300 mW
  - -10.5 dBm optical input sensitivity
  - +5 dBm optical overload



| Part Number | Data Rate (Gpbs) | Function                           | Transimpedance (k $\Omega$ ) | Input Overload (mAp-p) | Small Signal Bandwidth (GHz) | Noise (pA/ $\sqrt$ Hz) | Package |
|-------------|------------------|------------------------------------|------------------------------|------------------------|------------------------------|------------------------|---------|
| HMC799LP3E  | 0.1 - 1          | Low-noise Transimpedance Amplifier | 10                           | 20                     | 0.7                          | 4.6                    | LP3     |
| HMC690      | 10               | Transimpedance Amplifier           | 1.25                         | 3                      | 7.5                          | 11                     | Chip    |
| HMC7590     | 43               | Transimpedance Amplifier           | 3.5                          | 4.5                    | 32                           | 20                     | Chip    |

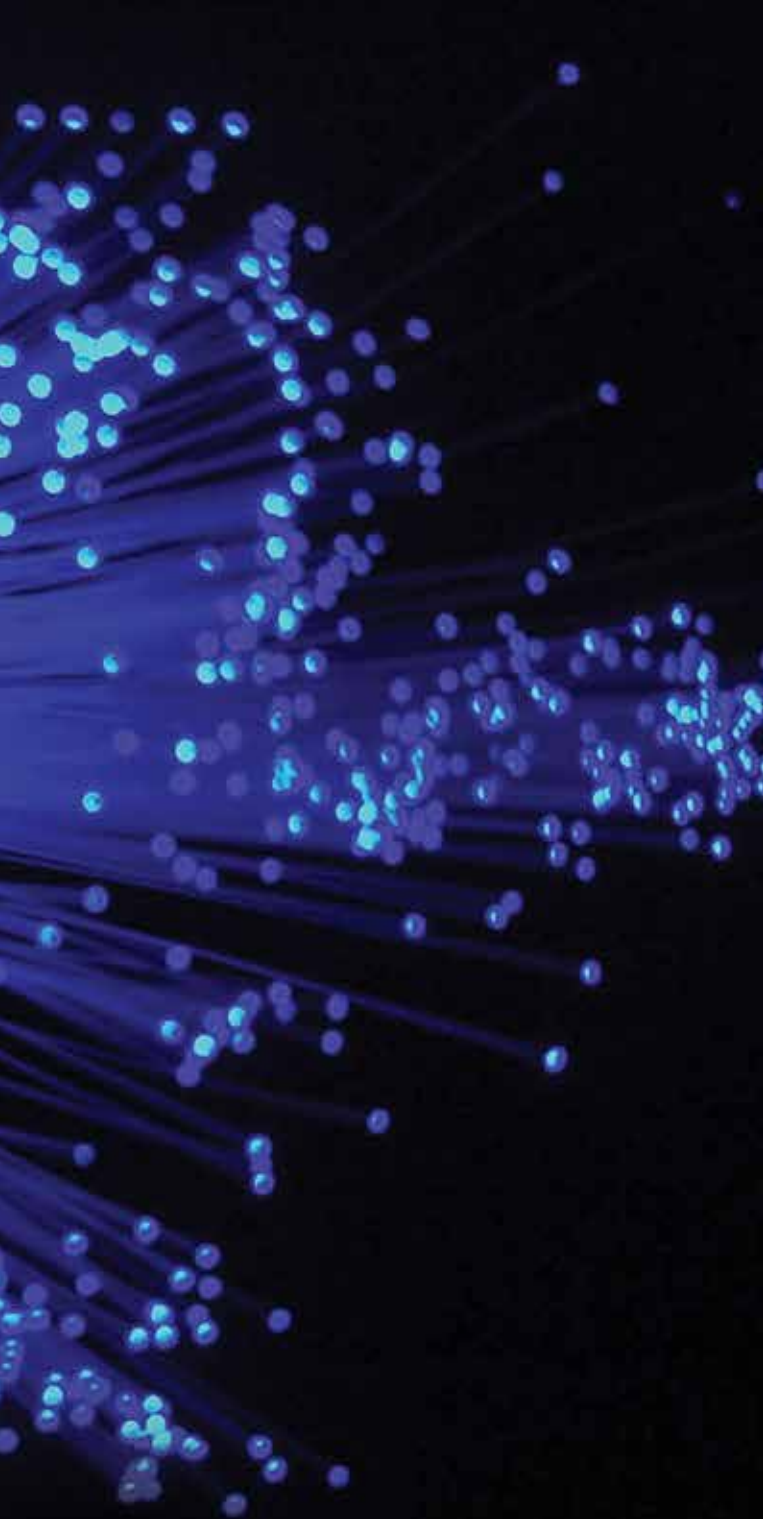
Ideal for 40 GbE-FR4, 40 Gbps VSR/SFF Optical Receivers

# TRANSIMPEDANCE AMPLIFIER

The **HMC7590** is a high-speed, high-gain, low-power limiting transimpedance amplifier (TIA) used in optical receivers with data rates up to 43 Gbps. It features low input referred noise, 36 GHz bandwidth, 4 k $\Omega$  differential small signal transimpedance and output cross point adjustment. The HMC7590 exhibits an optical input dynamic range between -10 dBm and +5 dBm while maintaining 10e-12 BER at 43 Gbps operation.

The device is available in die form, includes an on-chip VCC bypass capacitor. It requires only supply decoupling capacitor as external component.

The HMC7590 requires a single 3.3V  $\pm$ 5 % supply and it typically dissipates less than 300 mW. The device is characterized for operation from -5  $^{\circ}$ C to +85  $^{\circ}$ C case (IC back side) temperature.



## Hittite Microwave Worldwide Sales Offices

### Corporate Headquarters

**Hittite Microwave Corporation**  
**USA Corporate Headquarters**  
 Phone: 978-250-3343  
 Fax: 978-250-3373  
 sales@hittite.com

**Hittite Microwave International Ltd.,**  
**International Headquarters**  
 Phone: +353-21-4839000  
 Fax: +353-21-4839001  
 hmi@hittite.com

### Americas

#### Northeast

Boston, MA  
 Phone: 978-270-3167  
 usa-east-north@hittite.com

#### Southeast

Washington, D.C.  
 Phone: 312-485-8730  
 usa-east-south@hittite.com

### Central

Dallas, TX  
 Phone: 817-727-7146  
 usa-south@hittite.com

### Southwest

Los Angeles, CA  
 Phone: 626-961-5602  
 usa-west@hittite.com

### Northwest

San Jose, CA  
 Phone: 978-518-1792  
 usa-west-north@hittite.com

### Europe, Middle East & Africa

#### United Kingdom, Spain, & Portugal

**Hittite Microwave Europe Ltd.**  
 Phone: +44-7811-267418  
 Fax: +353-21-4839001  
 europe@hittite.com

#### Ireland, Greece, & Turkey

**Hittite Microwave International Ltd.**  
 Phone: +353-21-4839000  
 Fax: +353-21-4839001  
 hmi@hittite.com

### Benelux

**Hittite Microwave Deutschland GmbH**  
 Phone: +49-8031-97654  
 Fax: +49-8031-98883  
 germany@hittite.com

### France & Italy

**Hittite Microwave Sarl**  
 Phone: +33-6-0716-8079  
 Fax: +353-21-4839001  
 france@hittite.com

### Denmark, Finland, Norway, & Sweden

**Hittite Microwave Nordic AB**  
 Phone: +46-761-763969  
 nordic@hittite.com

Finland Office  
 Phone: +358 (0) 45-320-2626  
 finland@hittite.com

### Central & Eastern Europe

**Hittite Microwave Deutschland GmbH**  
 Phone: +49-8031-97654  
 Fax: +49-8031-98883  
 germany@hittite.com

### Asia & Pacific

**Australia & New Zealand**  
**Hittite Microwave International, Ltd.**  
 Phone: +353-21-4839000  
 Fax: +353-21-4839001  
 hmi@hittite.com

### India & Israel

**Hittite Microwave India Pvt., Ltd.**  
 Phone: +91-40-44311254  
 Fax: +91-40-44311100  
 india@hittite.com  
 israel@hittite.com

### Japan

**Hittite GK**  
 Phone: +81-3-5652-5772  
 Fax: +81-3-5652-6694  
 japan@hittite.com

### Korea

**Hittite Microwave Asia Co., Ltd.**  
 Phone: +82-2559-0638  
 Fax: +82-2559-0639  
 korea@hittite.com

### China

**Hittite Microwave Co., Ltd.**  
 Shanghai Office  
 Phone: +86-21-6209-8809  
 Fax: +86-21-6209-6730  
 china@hittite.com

Shenzhen Office  
 Phone: +86-755-3322-2116  
 Fax: +86-755-3322-2117  
 shenzhen@hittite.com

Beijing Office  
 Phone: +86-10-6485 9219  
 Fax: +86-10-6485 0377  
 beijing@hittite.com

Xi'an Office  
 Phone: +86-29-8885-7651  
 Fax: +86-29-8450-3797  
 china@hittite.com

## Sales Representatives

### Americas

#### Northeast

**Eastern Canada**  
**Ottawa, Quebec, Maritimes**  
 Repwave  
 +1-613-270-9811

#### Toronto, Southern Ontario

Repwave  
 +1-647-883-7360

#### New England

Microwave Marketing Specialist  
 978-392-0110

#### Western NY

Zimmerman Sales  
 585-381-3186

#### E. CT, Metro NYC, LI, No. NJ

Comp Tech  
 973-832-4545

#### Southeast

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 Vincent Pirro Electronics  
 410-961-3663

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Quad State Sales & Marketing  
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Matrix Design Technology  
 952-400-1070

### CO, ID, MT, UT, WY

Innovation Sales  
 303-652-3030

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**Argentina, Brazil**  
 Vermont Rep. Com. Ltd  
 +55-11-3726-6655

### Mexico

Quad State Sales & Marketing  
 972-669-8567

### AZ, NM

Saguaro Technical Sales, Inc.  
 480-947-3724

### So. CA

Acetec  
 858-784-0900

### HI, So. NV

Hittite Southwest  
 626-961-5602

### Northwest

**Western Canada**  
**BC, AB, SK, MB:**

Repwave  
 +1-604-929-8541

### No. CA, NV

Custom & Wireless Sales  
 408-371-0222

### OR, WA

Sea-Port Technical Sales  
 425-702-8300

### Europe, Mid-East & Africa

**Germany, Austria, Poland, Switzerland**

MEV Elektronik Service GmbH  
 +49-5424-2340-28

### Czech Republic, Estonia, Hungary, Latvia, Lithuania, Slovakia

Hittite Microwave Deutschland GmbH  
 +49-8031-97654

### Estonia, Latvia, Lithuania

Hittite Microwave Nordic AB  
 +46-761-763969

### Belgium, Luxembourg

Nijkerk Electronics N.V.  
 +32-3-544-70-66

### Bosnia Herzegovina, Bulgaria, Croatia, Macedonia, Romania, Serbia, Montenegro, Slovenia

IC Elektronika  
 +386(0)-1-568-01-18

### Denmark

Acte A/S  
 +45-46-900-400

### Netherlands

Nijkerk Electronics B.V.  
 +31-20-504-14-24

### Sweden

RF Partner AB  
 +46(0)-31-47-51-00

### Finland

Signal Solution OY  
 +358-400-460-646

### France

L-TEQ Microwave  
 +33-1-3007-7780

### Greece

**Hittite Microwave International, Ltd.**  
 +353 21 4839000

### United Kingdom, Ireland

Firefly Technology Ltd.  
 +44-1256-884980

### Israel

Starlight Technologies, Inc.  
 +972-3-9410555

### Italy

Special-Ind SPA  
 +39-02-6074741

### Norway

Bredengen AS  
 +47-2100-9100

### Russia

Radiant-Elcom Ltd.  
 +7-495-725-0404

### Spain, Portugal

Altaix Electronica S.A.L  
 +34-91-636-39-39

### South Africa

RF Design CC  
 +27-21-555-8400

### Turkey

EMPA Electronics  
 +90-212-465-71-99

### Asia & South Pacific

#### Australia, New Zealand

Braemac (SA) Pty Ltd.  
 +61-(0)-2-9550-6600

#### China, Hong Kong

Alignment Co., Ltd.  
 +86-755-8253-7068

Gateway Tech Co., Ltd.  
 +0755-8608-1010

### Wai Tat Electronics Ltd.

+852-2799-7393

### India

Syratron Technologies  
 +91-802-5591107/5591031

### Indonesia, Malaysia, Philippines, Singapore, Thailand:

MEs Technologies, Pte., Ltd.  
 +65-6453-8313

### Japan

Daito Electron Co., Ltd  
 +81-3-3237-1471

Hakuto Co., Ltd (FO & HSL)

+81-3-3355-7652

Mitsui Electronics

+81-3-6403-5804

### Korea

EZ Hightech

+82-31-382-6500

Infocube (FO & HSL)

+82-10-2483-5611

JS Commtech

+82-2-574-6100

Makus

+82-2-3490-9526

### Taiwan R.O.C.

Gateway Tech. Co., Ltd.

+886-2-8751-4918

## Instrumentation Sales Representatives

### North America

**AZ, CO, ID, MO, NM, UT & WY**  
 Technologies West RMS  
 602-312-3789

### Europe

**Belgium, Luxembourg, Netherlands**

AR Benelux B.V.  
 +31-172-423-000

### Greece

Vector Technologies, LTD  
 +30-210-68-58-008

### Italy

Giakova srl  
 +39-023-3512100

### Spain

AFC Ingenieros, S.A.  
 +34-91-365-44-05

### Turkey

Spark Olcum Teknolojileri Ltd. Sti  
 +90-312-466-8212

### United Kingdom

MCS Test Equipment LTD  
 +8453-62-63-65

### Asia

#### China

WAT-COM Technologies  
 +86-755-86233486

### Taiwan R.O.C.

T&E Communication  
 +886-2-82211259

### Japan

Farad  
 +81-3-5261-3091

### India

Convergent Technologies  
 +080-323670050-60



2 Elizabeth Drive • Chelmsford, MA 01824  
 978-250-3343 tel • 978-250-3373 fax  
[www.hittite.com](http://www.hittite.com) • [fo@hittite.com](mailto:fo@hittite.com)  
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**Наши контакты:**

**Телефон:** +7 812 627 14 35

**Электронная почта:** [sales@st-electron.ru](mailto:sales@st-electron.ru)

**Адрес:** 198099, Санкт-Петербург,  
Промышленная ул, дом № 19, литера Н,  
помещение 100-Н Офис 331