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- Applications
  - Mobile Communication
  - Consumer
  - Automotive & Industrial
  - ESD/EMI Protection
  - Lighting
General Transceiver RF Front-end Circuit

> Applications > Mobile Communication

- Low Noise Amplifier
  - RF Bipolar
    - BFP640 SiGe Transistors
    - BFP740 SiGe:C Transistor
    - BGA428 Si MMIC
    - BGA622 SiGe MMIC
    - BGA734L16 SiGe:C MMIC (TriBand)

- Antenna switches & Switched matching
  - (for PA in Dual/Triband)
  - RF PIN Diodes
    - BA892x
    - BAR63x
    - BAR64x
    - BAR65x

- Power Detection
  - RF Schottky Diodes
    - BAT15x
    - BAT68x
    - BAT62x
    - BAS70x

Recommended Products in RED!
Cellular Phone
ESD/EMI-Protection and RF Passive Integration

Applications > Mobile Communication

HiPAC Product Portfolio
ESD/EMI-Protection
ESD-Protection
H3-filter + Balun

Recommended Products in RED!
Antenna Switch Module (ASM)
Example: Triple Band Front End
> Applications > Mobile Communication

PIN Diode BAR63xx, BAR64xx, BAR65xx, BAR88xx, BAR89xx, BAR90xx

Recommended Products in RED!
Global Positioning System (GPS) for Mobile Phones

GPS Receiver

> Applications > Mobile Communication

- **LNA**: BGA615L7, BGA622(L7), BGA428, BFP700series, BFP460, BFP540ESD
- **ESD Protection**: ESDxPyRF-series

Recommended Products in RED!
Wireless LAN (802.11b/g)
2.4 GHz WLAN Front-End

> Applications > Mobile Communication

Antenna diversity

2.4 – 2.5 GHz

LNA

MMIC: BGA622L7

RF Transistor: BFP640 / 640F / 620 / 620F, BFP700series

Recommended Products in RED!
Cordless Phone (DECT, WDCT,...)
1.9 GHz Cordless Phone - Block Diagram

Applications > Mobile Communication

1.9 GHz

RX

LNA

BGA622(L7)

ANT SW

BAR63x, BAR64x, BAR88x, BAR89x, BAR90x, BAR65x

PA

BF776 + BFP650, BFP450

Recommended Products in RED!
RF Discretes for Cordless Phone
2.4GHz Cordless Phone

> Applications > Mobile Communication

- **LNA**: BGA622(L7)
- **PA**: 1. stage BF776, 2. stage BFP650, 3. stage BFP650
- **ANT SW**: BAR88x, BAR89x, BAR90x
- **MIX**: BFR300series, BFP540
- **Buffer**: BFR182T, BFR300Tseries
- **VCO**: BBY5xseries

Recommended Products in RED!
RF Discretes for Cordless Phone
5.8GHz Cordless Phone

> Applications > Mobile Communication

5.8 GHz

BPF

LNA
BFP700series, BF776

Buffer
BF776

PA
1. stage BFR740L3
2. stage BFR750L3
3. stage BFR750L3

Multiplier
BFP640

ANT SW
BAR50x
BAR89x
BAR90x

MIX
BF776

VCO
BFR300series
BBY5xseries

Recommended Products in RED!
Bluetooth (BT)
Front End for Bluetooth Class 1

> Applications > Mobile Communication

2.45GHz

RX

TX

Oscillator Module

Transceiver

LO

LNA

MMIC:
BGA622L7, BGA428
BGA427
BFP640 / 640F / 620
620F / 540F / 640
BFP700series

PA

RF Transistor:
BFP450

RF Transistor:
BFP420F, BFP540F, BFP620F
BFP640, BFR340F, BFR360F
BBY5X, BBY6X

ANT SW
BAR88x, BAR90x
BAR63x, BAR64x
BAR65x

Recommended Products in RED!
WiMAX Transceiver System

> Applications > Mobile Communication

WiMAX frequencies
Low: 2.3 – 2.7 GHz
Mid: 3.3 – 3.7 GHz

Recommended Products in RED!

**MMIC:** BGA622L7 (Low Band)

**LNA**

**RF Transistor:** BFP640 / 640F / 620 / 620F (Low & Mid Bands), BFP700series (Low & Mid Bands)

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VCO Module
for W-CDMA 2.1 GHz

> Applications > Mobile Communication

$V_{CTRL} \ 0.5 - 3.0 \ V$

$RF_{OUT}$

$f = 2110 \ MHz - 2170 \ MHz$

Varactor Diode: BBY58-02L
RF-Transistor: BFR360L3

Recommended Products in RED!
High Isolation Schottky Diode Pair for Power Detection

Applications > Mobile Communication

Schottky Diode Pair

PA

Detector Diode

Reference Diode

Differential Amplifier
to Antenna Switch

BAT62-09S, BAT63-07W
Table of Contents

- Applications
  - Mobile Communication
- Consumer
  - Automotive & Industrial
- ESD/EMI Protection
- Lighting
Wireless LAN (802.11b/g)
2.4 GHz WLAN Front-End

> Applications > Consumer

LNA

**MMIC**: BGA622L7 (2.4GHz - 802.11 b/g)

**RF Transistor**: BFP640 / 640F / 620 / 620F, BFP700series

Recommended Products in RED!
Wireless LAN (802.11b/g, a/b/g/n)
2.4 and 5 GHz WLAN Front-End

> Applications > Consumer

<table>
<thead>
<tr>
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<th>Component Type</th>
<th>Details</th>
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<tr>
<td>2.4 GHz</td>
<td><strong>LNA</strong></td>
<td>MMIC: BGA622L7, RF Transistors: BFP640 / 640F / 620F / 620F, BFP700series</td>
</tr>
<tr>
<td>5 GHz</td>
<td><strong>PA</strong></td>
<td>RF Transistor: BFP640 / 640F / 620F / 620F, BFP700series</td>
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<tr>
<td>2.4 &amp; 5 GHz</td>
<td><strong>FE-Module</strong></td>
<td>MMIC: T1515, BGA700L16</td>
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Recommended Products in RED!
Reference designs available at Infineon Tuner Devision:

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<td>Tuner</td>
<td>TUA6034 + TDA6192 + Demod*</td>
<td></td>
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<tr>
<td>ISDB-T</td>
<td>Tuner</td>
<td>TUA6034</td>
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<td>5V</td>
<td>Half-NIM</td>
<td>BBY5502W, BBY5602W, BFP540ESD, BF5030W, BG5130R</td>
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<tr>
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<td>Half-NIM</td>
<td>TUA6045</td>
<td></td>
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<tr>
<td>3V DVB-H/T UHF</td>
<td>Half-NIM</td>
<td>TUA6041</td>
<td></td>
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<tr>
<td>3V 3-band</td>
<td>Half-NIM</td>
<td>TUA6041</td>
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*Demodulator IC from Co-operation partner
Module Tuner for Analog / Cable / Terrestrial

> Applications > Consumer

**MOSFET VHF III/UHF**
- BG3130/R (Dual)
- BG3123/R (Dual)
- BG5130R (Dual)

**MOSFET VHF I/II**
- BF2030W
- BF2040W
- BF5030W

**Varactor Diode VHF III/UHF**
- BB659C, BB664
- BB689, Switching: BA892/02L

**Varactor Diode VHF I/II**
- BB555
- BB565

Recommended Products in RED!
T-DMB/DAB in VHF Band III and L-Band

Applications > Consumer

VHF III 170MHz-240MHz

- Mixer
- Oscillator
- PLL
  - e.g. TUA6045

L-Band

- Tank Circuit

Recommended Products in RED!

- **LNA**: BFP460*, BFP540ESD*
  *ESD hardened*

- **ESD Protection**: ESDxPyRF-series

- **Tuner Filter/BBY55-02W, BBY56-02W**

- **Tank Circuit**

- **MOSFET**: BF5030W

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FM Tuner

> Applications > Consumer

- **RF signals**
  - FM
  - AM
- **Prestage**
- **Tuned Filter**
- **Oscillator PLL IC**
- **Fixed IF signal**
- **Oscillator Tank Circuit AM + FM**

### Recommended Products in RED!

- **Varactor diode**
  - BB804
  - BB814
  - BB844
  - BB914
- **MOSFET**
  - BF998R
  - BF999
  - BF1009SR
- **Gain control**
  - BC848
  - BAR14-1, BAR61
  - BA595, BA895
Si-Tuner System for CATV/DVB-T

> Applications > Consumer

CATV / DVB-T: 40 ... 860 MHz

- **LNA**
  - BFP460*, BFP540ESD*, BFP700series
  - BGA622(L7), BGA612, BGA614, BGA616

- **ESD Protection**
  - ESDxPyRF-series

*ESD hardened

Recommended Products in RED!

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Si-Tuner System for Mobile TV

> Applications > Consumer

DVB-H: VHF III/UHF/L-Band
DVB-S: 950...2150MHz

---

LNA

BGA622(L7), BGA612, BGA614, BGA616
BFP460*, BFP540ESD*, BFP700series

*ESD hardened

ESD Protection

ESDxPyRF-series

Recommended Products in RED!
Active Antenna (Tuner, Cellular, GPS) for Portable Applications

> Applications > Consumer

- **1st/2nd LNA**: BFP700series, BFP640, BFP640F
- **3rd LNA**: BFP650
- **ESD Protection**: ESDxPyRF-series

Recommended Products in RED!
WiMAX Transceiver System

> Applications > Consumer

**WiMAX frequencies**
- High: 5.7 – 5.9 GHz
- Mid: 3.3 – 3.7 GHz
- Low: 2.3 – 2.7 GHz

**Recommended Products in RED!**

<table>
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<th><strong>LNA</strong></th>
<th><strong>MMIC:</strong></th>
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<td></td>
<td>BGA622L7 (Low Band),</td>
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<td>T1515 &amp; BGA700L16 (Low / High Band)</td>
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<tr>
<td>RF Transistor:</td>
<td>BFP640 / 640F / 620 / 620F (Low / Mid / High Band),</td>
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<td></td>
<td>BFP700series (Low / Mid / High Band)</td>
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UWB Transceiver System

> Applications > Consumer

- Antenna diversity
- DPDT Switch
- Broadband Filter
- LNA
- BFP700series
- Balun
- Broadband Filter
- UWB TRX IC
  - Data Modulation (UWB Puls Generation)
  - Correlation Receiver
  - BaseBand IC

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Bluetooth (BT)
Front End for Bluetooth Class 1

> Applications > Consumer

2.45GHz

RX

TX

2.45GHz

Oscillator

Module

Transceiver

LNA

MMIC:

BGA622L7, BGA428
BGA427

RF Transistor:

BFP640 / 640F / 620
620F / 540F / 640
BFP700series
BAR88x, BAR90x
BAR63x, BAR64x
BAR65x

PA

BFP450

ANT SW

RF Transistor:

BFP640 / 640F / 620
620F / 540F / 640
BFP700series
BAR88x, BAR90x
BAR63x, BAR64x
BAR65x

LO

BFP420, BFP540, BFP620F
BFP640, BFR340F, BFR360F
BBY5X, BBY6X

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SMM310 Si-MIC for Portable Applications

> Applications > Consumer

SMM310 Si-Microphone with integrated EMC-Capacitor

Silicon Microphone

SMM310 Si-Microphone with integrated EMC-Capacitor

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Active Bias Controller/Universal Current Source for GaAs and BJT Transistors/MMICs

> Applications > Consumer

Vcc (2 ... 18V)

Output Matching

Input Matching

Bip-Tr.

Current Source

BCR400W, BCR401R, BCR402R, BCR410W
Bridge Rectifier Diode for Power Supplies

> Applications > Consumer

![Diagram of AC to DC power conversion with Bridge Rectifier BGX50A and EMI/EMC filter]

**Bridge Rectifier**

BGX50A

Recommended Products in RED!
PC Motherboard
Protection devices and discrete components

> Applications > Consumer

### ESD/EMI Interface protection
- USB
- Firewire
- TV Out
- VGA Out
- CardReader
- External Storage

### Discretes content
- AF Transistors for current & voltage supply
- switching and drivers
- AF switching diodes
- Clipping & Clamping Schottky Diodes

### Protection diode
- ESDOP8RFL, ESD5V0Sx, ESD8VOLxx

### AF transistors
- BCRxx, BCxx, SMBTxx

### AF Diodes
- BATxx, BASxx, BAVxx

### ESD/EMI HiPAC & TVS diodes
- HiPAC: BGF110, BGF104, BGF109, BGF100, BGF200
- Discrete Solution*: ESDOP8RFL, ESD5V0Sx, ESD8VOLxx

*) w/o EMI filtering
Table of Contents

- Applications
  - Mobile Communication
  - Consumer
  - Automotive & Industrial
  - ESD/EMI Protection
  - Lighting
TPMS, RKE & Remote Start
KeyFob, Receiver Solution for long Antenna Range

> Applications > Automotive

e.g. 315 / 434 MHz

Receiver IC
e.g. TDA523X

Bandpass Filter
(Optional)

Rx LNA
BFP460*, BFP540ESD*
*ESD Hardened

Rx ESD Protection
ESDxPyRF-series

RKE KeyFob for Remote Start e.g. Aircon etc.

Osc/Buffer
RF Transistors: BFR182

Tx PA
RF Transistors: BFP450
Car Alarm Transceiver Solution
(KeyFob and Car Unit)

> Applications > Automotive

e.g. 315 / 434 MHz

RX

TX

Transceiver IC
e.g. TDA5255

LNA

ESD Hardened RF Transistors:
BFP460*, BFP540ESD*
* ESD Hardened

ANT SW

BAR50x
BAR89x
BAR90x

PA

MMIC: BGA616
RF Transistors: BFP450, BFP650

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Global Positioning System (GPS)

GPS Receiver

> Applications > Automotive

1575.42 MHz

LNA

BGA615L7, BGA622(L7), BGA428
BFP640, BFP460*, BFP540ESD* – * ESD Hardened RF-Transistor

ESD Protection

ESDxPyRF-series

Recommended Products in RED!
Active Antenna (Tuner, Cellular, GPS, SDARS...)  
Example: Solution for SDARS Radio 2332.5 - 2345 MHz

> Applications > Automotive

![Diagram of antenna system with 1st LNA, 2nd LNA, BPF, 3rd LNA, Coax cable, and Approx. 14dB loss]

- 1st LNA: BFP740, BFP640, BFP640F
- 3rd LNA: BFP650
- ESD Protection: ESDxPyRF-series

Recommended Products in RED!
ZigBee
low power digital radio system up to 2.5 GHz

> Applications > Automotive

LNA
RF Transistors: BFR705L3RH, BFP540ESD, BFP700series
MMIC: BGA622, BGA428

Driver
RF Transistors: BFP450, BFP650
MMIC: BGA612, BGA614, BGA616, BGA420

PIN Diode Switch
BAR88x, BAR90x, BAR63x, BAR64x, BAR65x
Electronic Toll Collect (ETC)
ETC - 5.8GHz Electronic Toll Collect

> Applications > Automotive

![Diagram showing the block diagram of an ETC system]

- **LNA**
  - **RF Transistors**: BFP640F, BFP700series

- **PA**
  - **RF Transistors**: 2xBFP520+BFP650

- **LO**
  - **BBY5X..., BBY6X...**

- **ANT SW**
  - **BAR50-02L**

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Discrete Based Oscillator for RKE (Remote Keyless Entry) KeyFob

> Applications > Automotive

VCC (2.4 V ... 3.2 V)

f = 315 MHz

Icc = 6 mA (CW-mode)

Pout = 8.3 dBm @ 50 Ω

RF-Transistor: BFR182

Recommended Products in RED!
Schottky Diodes for 24GHz Radar System

> Applications > Automotive

Double-Balanced Mixer

24GHz

LNA

Balun

BB/IF

Balun

Buffer Amplifier

VCO

RF Schottky Diode

BAT24-02LS
Automotive CAN Network
ESD-protection of CAN Bus Transceiver

- w/o external TVS: ≤8kV contact
- w external TVS: >30kV contact

CAN Transceivers

ESD Protection
ESD24VS2B
Engine/Injection Management

> Applications > Automotive

**Engine Management Unit**

**Gasoline Injection Management Unit**

**Schottky diodes**
- BAS16
- BAS21
- BAS28
- BAS70-05

**AF diodes**
- BAV170
- BAW101

**Transistor**
- BCP51
- BCV46
- BC847PN
- BC817
- BC807

**Small Scale Integration Devices**

**Active Bias Controller**
- BCR400W or BCR410W

**LED driver**
- BCR40xU
Convenience and Safety

> Applications > Automotive

Door Module: Side Mirror

Airbag Module

Window Lifter

Seat Drives

E.g. door module:

- **AF Transistors**: 3x BC847S, 5x BC857S, 1x BC817-40, BC817SU
- **Digital Transistors**: 2x BCR135, 2x BCR185
- **AF Diodes**: 1x BAT64, 2x BAV70
- **LED driver**: BCR40xU
- **CAN ESD Protection**: ESD24VS2B
Home: Comfort, Control and Security

> Applications > Industrial

- Wireless sensor hub
- Wireless smoke detector
- Wireless glass break detector
- Wireless motion sensor
- Wireless door/window contact
- Thermostat Control (radiator side)
- Thermostat Control (operator side)
Home Comfort, Control and Security
Thermostat Control – radiator side (EU: 868 MHz)

> Applications > Industrial

µ controller

RF - Tx

RF - Rx

e.g. TDA5255

Stepper motor driver

RF - Tx

RF - Rx

SPDT

LNA

BFP460*, BFP540ESD* – * integrated ESD protection

System ESD Protection

ESDxPyRF-series

Driver

Discrete: BFP450 + BFP405
MIMIC: BGA622L7, BGA612, BGA614, BGA616

PIN Diode Switch

BAR88x, BAR90x, BAR63x, BAR64x, BAR65x

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Home Comfort, Control and Security
Thermostat Control – operator side

> Applications > Industrial

- LNA
  - BFP460*, BFP540ESD* – * integrated ESD protection

- System ESD Protection
  - ESDxPyRF-series

- Driver
  - Discrete: BFP450 + BFP405
  - MIMIC: BGA622L7, BGA612, BGA614, BGA616

- PIN Diode Switch
  - BAR88x, BAR90x, BAR63x, BAR64x, BAR65x
Home Comfort, Control and Security
Wireless smoke sensor hub (EU: 868MHz / NAFTA: 434MHz)

> Applications > Industrial

![Diagram of a wireless smoke sensor hub]

- **LNA**: BFP460*, BFP540ESD* – * integrated ESD protection
- **ESD Protection**: ESDxPyRF-series
- **Driver**: Discrete: BFP450 + BFP405
  MIMIC: BGA622L7, BGA612, BGA614, BGA616
- **PIN Diode Switch**: BAR88x, BAR90x, BAR63x, BAR64x, BAR65x

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Home Comfort, Control and Security
Wireless smoke sensor

> Applications > Industrial

- **LNA**: BFP460, BFP540ESD – integrated ESD protection
- **ESD Protection**: ESDxPyRF-series
- **Driver**: Discrete: BFP450 + BFP405
  MIMIC: BGA622L7, BGA612, BGA614, BGA616
- **PIN Diode Switch**: BAR88x, BAR90x, BAR63x, BAR64x, BAR65x

- **Switch**
- **RF - Tx**
- **RF - Rx**
- **μ controller & NV memory**
- **Smoke sensor**

e.g. TDA525x
Home Comfort, Control and Security
RF controlled set top box

> Applications > Industrial

- SMPS
- MODEM
- Connection Ports
- μC
- HDD
- USB
- IR sensor
- uCOM
- Controls
- RF - Rx
- Smart Card
- LNA
- BFP460*, BFP540ESD* – * integrated ESD protection
- ESD Protection
- ESDxPyRF-series
RF Metering, AMR (Automatic meter reading)
RKE Based

433.9MHz

Driver Amplifier
3x BFP460*
* integrated ESD

LNA
BFP405

ESD Protection
ESDxPyRF-series

PIN Diode Switch
BAR88x, BAR90x, BAR63x,
BAR64x, BAR65x

Varactor Diode
BBYxx
Cellular Phone
ESD/EMI-Protection and RF Passive Integration

> Applications > ESD/EMI Protection

HiPAC Product Portfolio

ESD/EMI-Protection

ESD-Protection

H3-filter + Balun

Recommended Products in RED!
Portable System
MP3 player, digital camera, camcorder...

> Applications > ESD/EMI Protection

**ESD/EMI HiPACs**

- **HiPAC for LCD**
  - Discrete Solution*
  - BGF108, BGF109, BGF109L
  - ESD0P8RFL, ESD5V0Sx, ESD8V0Lxx

- **HiPAC for MMC/SD MemCard**
  - Discrete Solution *
  - BGF104, BGF110
  - ESD0P8RFL, ESD5V0Sx, ESD8V0Lxx

- **HiPAC for Microphone**
  - Discrete Solution *
  - BGF100, BGF200
  - ESD0P8RFL, ESD5V0Sx, ESD8V0Lxx

*) w/o EMI filtering

Protection diode

ESDOP8RFL, ESD8VOLxx

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ESD/EMI Protection for Microphone Interface
(pseudo differential and/or Single-Ended Mode/Mono) with BGF200

> Applications > ESD/EMI Protection
ESD/EMI Protection for Microphone Interface (pseudo Single-Ended Mode) with BGF200

Applications > ESD/EMI Protection

BGF200

SMM310 Si-Microphone with integrated EMC-Capacitor

Baseband IC

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High Speed MMC Card ESD/EMI Protection with BGF104

> Applications > ESD/EMI Protection

![Diagram of MMC Card Connector](image)

- For x8 HSMC Card Only
- x4 HSMC Card

**BGF104**

- Connections:
  - DAT2, DAT3, CMD, $V_{SS1}$, $V_{DD}$, CLK, $V_{SS2}$, DAT0, DAT1

**MMC Card Connector**

- Connections:
  - DAT2, DAT3, CMD, $V_{SS1}$, $V_{DD}$, CLK, $V_{SS2}$, DAT0, DAT1

Flash Controller IC

- Connections:
  - $V_{DD}$, CLK, CMD, DAT0, DAT1, DAT2, DAT3

- * not applicable for CLK line
SIM Card Interface Protection
with BGF105

> Applications > ESD/EMI Protection
ESD/EMI protection for digital displays with BGF109 for LCD, TFT applications

> Applications > ESD/EMI Protection

1) Flexible Printed Circuitry

HiPAC   BGF109

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Secure Digital Card ESD/EMI Protection
BGF110

> Applications > ESD/EMI Protection

Note:
WP: Write Protection
CD: Card Detection
PU: Pull-Up
PD: Pull Down

* not applicable for CLK, DAT3, CD, WP and WP+CD lines
ESD/EMI Protection for Digital Data Interface with 4/7/10-Channel Diode & Low-Pass Filter

> Applications > ESD/EMI Protection

HiPAC

- BGF111 (1 Channel)
- BGF105 (4 Channel)
- BGF108 (7 Channel)
- BGF109 (10 Channel)

New Products in RED!
General Purpose ESD & Surge Protection with 1-5-Channel TVS Diode Arrays (upto 5V Supply Voltage)

Applications > ESD/EMI Protection

Uni-Directional : ESD5V0S1U-03W (1-channel)
                  ESD5V0S2U (2-channel)
                  ESD5V0S5US (5-channel)

Bi-Directional:  ESD8V0L1B-02LRH (1-channel)
                  ESD8V0L1B-03L (2-channel)
General Purpose ESD & Surge Protection with 2-Channel TVS Diode Array (upto 24V Supply Voltage)

> Applications > ESD/EMI Protection

ESD Diode: ESD24VS2B (2-Channel)
High-Speed ESD & Surge Protection
Designed for USB2.0, 10/100 Ethernet, Firewire, …

> Applications > ESD/EMI Protection

ESD Diode: ESD8V0L1B-02LRH

ESD Array: ESD8V0L2B-03L
ESD, EFT & lightning protection
ADSL, ISDN, WAN or other telecom application (rail-to-rail)

> Applications > ESD/EMI Protection

**TVS Diode Array:** ESD70VU2RR-07
Automotive CAN Network
ESD-protection of CAN Bus Transceiver

> Applications > ESD/EMI Protection

- w/o external TVS: ≤8kV contact
- w external TVS: >30kV contact

CAN Transceiver

CAN High

CAN Low

CAN Bus

ESD Protection

ESD24VS2B

CAN Bus
RF Antenna Port
ESD Protection of with Low-Capacitance ESD Diodes

> Applications > ESD/EMI Protection

ESD Protection

ESD0P8RFL \((C_L = 0.8 \text{ pF})\)
ESD1P0RFW (1-Channel) \((C_L = 1.0 \text{ nF})\)
ESD1P0RFS (2-Channel) \((C_L = 1.0 \text{ pF})\)

Recommended Products in RED!
Reverse Polarity Protection
Protection against reverse polarity

> Applications > ESD/EMI Protection

Prevents damage to the circuit

System works with reverse polarity

**Schottky Diode:**
BAS3005A-02V, BAS3010S-03LRH*, BAS3010A-03W, BAS3020B*

**Schottky Diode Array:**
BAS3007A-RPP*  

*New Products on request*
Clipping and Clamping
Transient Voltage Suppression

> Applications > ESD/EMI Protection

Protection Diode: BAT17xx, BAT62xx, BAT54xx, BAT64xx, BAT68xx, BAS40xx, BAS70xx, BAS125xx
# Table of Contents

- **Applications**
  - Mobile Communication
  - Consumer
  - Automotive & Industrial
  - ESD/EMI Protection
  - Lighting
Why are LED-Drivers needed?

> Applications > Lighting

**Protection**
- Overvoltage
- Overcurrent
- Excessive Temperature

**Control**
- Brightness Control
- LED Cluster Control
- Binning Compensation
- RGB Color Management
- Realisation of Bus-Interfaces for Parallel Driving
Driving LED-Chains directly (up to 65 mA)

Applications > Lighting

LED-Driver: BCR401R/W/U, BCR402R/W/U, BCR405U

Schottky Diode Array: BAS3010S-03LRH*, BAS3010A-03W, BAS3020B*

* New product on request
Driving LED-Chains using a Booster Transistor (up to 500 mA)

> Applications > Lighting

Reverse Polarity Protection

**LED-Driver:** BCR401R/W/U, BCR402R/W/U, BCR405U

**Booster Transistor:** BCX55-16, BCX68-25, BC817SU

**Schottky Diode Array:** BAS3010S-03LRH*, BAS3010A-03W, BAS3020B*

* New product on request
# Table of Contents

- **RF Discretes**
  - Introduction
  - RF Transistors
  - RF MMICs
  - RF Diodes
  - RF PIN Diodes
  - RF Varactor Diodes
  - RF Mosfet
RF Product Range and Target Applications

RF Discretes > Introduction

RF Products

- RF Building Blocks
  - Low Noise Amps
  - 50W Driver stages
  - Single chip VCOs
  - Gain blocks

- RF MMIC
- RF Transistors
- RF MOSFETs
- RF PIN Diodes
- RF Varactor Diodes
- RF Schottky Diodes

Applications

- Cellular Terminals
- Cordless Terminals
- Base Stations
- LNB Downconverter
- CATV Amplifier
- FM/VHF/UHF/SAT Tuner
- Set Top Box
- WLAN
- Wireless Local Loop
Table of Contents

- RF Discretes
  - Introduction
- RF Transistors
- RF MMICs
- RF Diodes
- RF PIN Diodes
- RF Varactor Diodes
- RF Mosfet
RF Transistors Portfolio at a glance

> RF Discretes > RF Transistors

1. Generation
2.5 GHz
... BFS17W, BFS17P, BF799W, BF517 ...

2. Generation
5 - 6 GHz
... BFR93(T) ... BFP194, BF770A ...

3. Generation
6 - 8 GHz
... BFR193(T) ... BF771(W), BF772 ...

3+ Generation
15 GHz

4. Generation
25 GHz

4minus Gen.
23 GHz

5. Generation
45 GHz

5. Generation
BFP520(F), BFP540(F)
BFP540ESD
BFP405, BFP420, BFP450
BFP450F, BFP420F

6. Generation
SiGe
for very Low Noise Amp.

BFP460, BFR460L3
DUAL BFS4XX in TSLP-6

6. Generation
SiGe:C
for Ultra Low Noise

BFP640, BFP640F, BFP650
BFP620, BFP620F

BFR340F, BFR360F, BFR380F
BFR3XX in TSLP-3
DUAL BFS3XX in TSLP-6

7. Generation
SiGe:C
for Ultra Low Noise

BFR193L3, BFR949L3
G.P. in TSLP

Ultra Low Noise

ESD!

ESD!

ESD!

integ. ESD 1500V*

* Typ. HBM

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BFP740series
... Keeping the Leadership in RF Performance
> RF Discretes > RF Transistors

Ultra Low Noise SiGe:C Heterojunction Bipolar Transistor (HBT)

Performance
- $f_T$ of 42 GHz
- $\text{NF} = 0.5 \text{ dB at 2 GHz}$
- $\text{NF} = 0.8 \text{ dB at 6 GHz}$
- $G_{ms} = 28 \text{ dB at 1.8 GHz}$

Benefits & Arguments
- Lowest noise figure level currently available in the SiGe:C market
- Comparable to GaAs MESFET and pHEMT
- No negative supply voltage required (unlike GaAs FETs)
- High Gain & Low Current Operation

Present solutions for ultra low noise at 6GHz

<table>
<thead>
<tr>
<th>NFmin at 6GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 dB</td>
</tr>
<tr>
<td>1.0 dB</td>
</tr>
<tr>
<td>1.5 dB</td>
</tr>
</tbody>
</table>

Applications (LNA)
- 1.2 – 1.3GHz, 1.575GHz GPS-Systems
- 2.1 – 2.4GHz: UMTS, DECT (EU), 2.4 GHz ISM
- 2.33 GHz, 2.6 GHz SDARS Satellite Radio (NA), DMB
- 5 – 6 GHz: WLAN, Cordless Phone, DSRC
- 3 – 10 GHz: UWB (NA)
- 12 GHz Satellite TV (Asia, EU, NA), LNB

Ultra Low Noise SiGe:C Heterojunction Bipolar Transistor (HBT)
Infineons Ultra Low Noise SiGe:C HBTs
BFR700L3RH (reduced height) Series

RF Discretes > RF Transistors

- Outstanding Performance
- Wide Range of Wireless Applications up to 10GHz
- High Gain
- Ultra Low Noise

BFR740L3RH

*Key Data:
- $V_{CEO} = 4V$, $I_{CMAX} = 30mA$
- $NF = 0.5dB$ at 1.8GHz, 3V, 8mA
- $G_{MS} = 24\, dB$ at 1.8GHz, 3V, 25mA

* for more details pls. check datasheet

- Low Power Consumption
- Low Current Operation
- High Gain
- Ultra Low Noise
- portable GPS, WLAN, UWB

BFR705L3RH

*Key Data:
- $V_{CEO} = 4V$, $I_{CMAX} = 10mA$
- $NF = 0.5dB$ at 1.8GHz, 3V, 3mA
- $G_{MS} = 24\, dB$ at 1.8GHz, 3V, 7mA

- Medium Power Device
- High IP3, P-1dB
- Very Low Noise
- Discrete PA (driver)
- 5.8GHz Cordless Phone

BFR750L3RH

*Key Data:
- $V_{CEO} = 4V$, $I_{CMAX} = 90mA$
- $NF = 0.6dB$ at 1.8GHz, 3V, 25mA
- $G_{MS} = 20\, dB$ at 1.8GHz, 3V, 60mA
- $P_{1dB} = 17dBm$ at 1.8GHz, 3V, 60mA
- $IP3 = 29dBm$ at 1.8GHz, 3V, 60mA

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Wideband Feedback LNA for <200 MHz up to 6 GHz
Using SiGe RF Transistor BFR740L3RH

> RF Discretes > RF Transistors

**Applications**

- 315, 433 MHz: Remote Keyless Entry
- 900 MHz: Cellular, 900 MHz ISM, etc.
- 1575 MHz: GPS
- 2400 MHz: 2.4 GHz ISM, WLAN, etc.
- 5150 MHz: IEEE802.11a WLAN

**Features**

- The complete amplifier only uses 16mm² of PCB area
- A simple, low-cost general-purpose wideband LNA application
- Gain of 19.8-10.0 dB @ 315-5100 MHz
- Noise Figure of 1.1 – 1.5 dB @ 315-5100 MHz

**BFR740L3RH**

- Leadless
- TSLP-3
- 1.0 x 0.6 x 0.32mm

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LNA for 1575 MHz GPS (Global Positioning System) Using the SiGe Transistor BFP740F in TSFP-4 Package

> RF Discretes > RF Transistors

Applications

- 1575.42 MHz GPS LNA

Overview

- Gain of 19.8 dB @ 1575 MHz
- Noise Figure of 0.67 dB @ 1575 MHz
- Input P1dB of -18.0 dBm @ 1575 MHz
- Output P1dB of +0.8 dBm @ 1575 MHz
- Input 3rd Order Intercept of -1.7 dBm @ 1575 MHz
- Current < 8.2 mA from a 3.0 Volt power supply
- Input / Output Return Loss 10 dB or better
Narrowband 5 to 6 GHz (IEEE802.11a WLAN) LNA Using SiGe RF Transistor BFP740F

> RF Discretes > RF Transistors

Applications

- 5 to 6 GHz (IEEE802.11a WLAN) LNA

Excellent Results

- NF ~ 1.1 dB on PCB @ 5 to 6 GHz substantial improvement over BFP640 ... and better than GaAs pHEMT
- Application Board on request
SiGe RF Transistors
BFP600 Family

> RF Discrete > RF Transistors

- 70 GHz $f_T$ - Silicon Germanium technology
- Gold metallization for extra high reliability

**BFP640/F**
- For a wide range of wireless applications
- Ideal for LNB, CDMA and WLAN applications
- High gain, low noise RF transistor
- Provides outstanding performance
- High maximum stable gain $G_{ms} = 24$ dB at 1.8 GHz
- Outstanding noise figure $NF = 0.65$ dB at 1.8 GHz
  $NF = 1.4$ dB at 6 GHz

**BFP640, 650**
- Standard
  - SOT343
  - 2.0 x 1.25 x 0.9mm

**BFP650**
- For medium power amplifiers
- Ideal for low phase noise oscillators
- Output compression point $P_{1dB} = 18$ dBm at 1.8 GHz
- Max. available Gain $Gma = 21$ dB at 1.8 GHz
- Noise figure $NF = 0.8$ dB at 1.8 GHz

**BFP640F**
- Flatlead
  - TSFP-4
  - 1.2 x 0.8 x 0.55mm
Low-Current LNA for 1575 MHz GPS Applications Using the SiGe BFP640 Transistor

> RF Discretes > RF Transistors

Applications

- 1575.42 MHz GPS LNA

Overview

- Gain of 15.2 dB@ 1575 MHz
- Noise Figure of 0.95 dB @ 1575 MHz
- Input P1dB of -18.7 dBm @ 1575 MHz
- Output P1dB of -4.5 dBm @ 1575 MHz
- Input 3rd Order Intercept of -1.1 dBm @ 1575 MHz
- Current of 4.9 mA from a 3.0 Volt power supply
- Input/Output Return Loss better than 10 dB
Applications

- 2.3 GHz SDARS, 2.4 GHz (Bluetooth, WLAN, other 2.4 GHz ISM applications)

Overview

- Gain = 15.5 dB @ 2400 MHz
- Noise Figure ~ 0.96 dB @ 2400 MHz
- Input P1dB of -11.3 dBm @ 2400 MHz
- Output P1dB +3.2 dBm @ 2400 MHz
- Input 3rd Order Intercept +11.6 dBm @ 2400 MHz
- Current of 6.7 mA from a 3.0 Volt power supply
LNA for **Satellite DMB (Digital Multimedia Broadcasting)** Using the BFP640 Transistor

> RF Discretes > RF Transistors

**Applications**

- 2630 – 2655 MHz Digital Multimedia Broadcasting

**Overview**

- Gain = 14.8 dB@ 2642.5 MHz
- Noise Figure of 1.0 dB @ 2642.5 MHz
- Input P1dB of -11.6 dBm @ 2642.5 MHz
- Output P1dB of + 2.2 dBm @ 2642.5 MHz
- Input 3rd Order Intercept of +8.7 dBm @ 2642.5 MHz
- Current of 5.8mA from a 3.3 Volt power supply
Two-Stage LNA for 5 to 6 GHz (IEEE802.11a WLAN) Using SiGe Transistor BFP640

> RF Discretes > RF Transistors

Applications
- Frequency Range 5 to 6 GHz

Overview
- Low Cost Solution
- Results achieved on FR4
- Supply Voltage 3.3V
- DC Current 16.2 mA
- Gain 22.3 dB @5350 MHz
  20.4 dB @5825 MHz
- Noise Figure 1.54 dB @5350 MHz
  1.62 dB @5825 MHz
- Input P_{1dB} -14.8 dBm @5825 MHz

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Two-Stage LNA for 5 to 6 GHz (IEEE802.11a WLAN) Using SiGe Transistor BFP640 – reduced ext. components

> RF Discretes > RF Transistors

Applications

- Frequency Range 5 to 6 GHz

Overview

- Low Cost Solution
- only 7 passive (3xC, 3xR, 1xL)
- Results achieved on FR4
- Total PCB area 40mm²
- Supply Voltage 3V
- DC Current 9 mA
- Gain (can be increased by Ic)
  - 10.1 dB @5500 MHz
- Noise Figure 1.4 dB @5500 MHz

Inductors are Murrata LQ15M Series (formerly LQ10A) 0402 case size. Capacitors and resistors are 0402 case size.

PCB = 640-062402 Rev C
PC Board Material = Standard FR4

Note: black rectangles are 50 ohm traces or "tracks" on the Printed Circuit Board - these marks are NOT Surface Mount Components.

"X" mark indicates components to be eliminated with new circuit.
8 – 9 GHz $f_T$ G.P. RF Transistors in TSLP-3-1

> RF Discretes > RF Transistors

- Bipolar 8 and 9 GHz Silicon technology in Leadless Packages
- Ideal for General Purpose RF Applications e.g. LNAs, Oscillators and VCO Modules

- Ideal for Low Noise and High Gain Broadband Amplifiers at Collector Currents from 1mA to 20mA
- Transition Frequency of 9GHz
- NF of 1.0dB at 1GHz
- $V_{CE0}=10V$, $I_C=35mA$

- For low noise, high-gain amplifiers up to 2 GHz
- For linear broadband amplifiers
- Transition Frequency of 8 GHz
- NF of 1.2 dB at 900 MHz
- $V_{CE0}=12V$, $I_C=80mA$

Footprint 1.0 x 0.6 x 0.4mm only!
14GHz RF Transistors

- Bipolar 14 GHz Silicon technology in Flatlead and Leadless Packages
- Ideal for Low Phase Noise Oscillators and VCOs

### BFR340F/L3

- Ideal for Low Current and Amplifiers and Oscillators
- High Transition Frequency of 14GHz
- High Insertion Gain
- Low Voltage/ Low Current Operation
- VCE0=6V, IC=10mA

### BFR360F/L3

- For Low Voltage / Low Current Applications
- For Oscillators up to 3.5GHz and Pout > 10dBm
- For Low Noise Amplifiers
- Low Noise Figure: 1.0 dB at 1.8 GHz
- VCE0=6V, IC=35mA

### BFR380F/L3

- High Current Capability and Low Noise Figure for Wide Dynamic Range Applications
- Ideal for Low Phase Noise Oscillators up to 3.5GHz
- Low Voltage Operation
- Low Noise Figure: 1.1dB at 1.8GHz
- VCE0=6V, IC=80mA

---

TSFP-3 Package
BFRxxxF

TSLP-3 Package
BFRxxxL3

Footprint 1.0 x 0.6 x 0.4mm only!
14GHz f_T Twin RF Transistors in TSLP-6 VCO and RF Modules

- RF Discretes > RF Transistors

- TWIN Type 14GHz Low Phase Noise RF-Transistors in Ideal for Oscillators and VCOs Modules
- Two built in Transistors in 6pin Thin Small Leadless Package TSLP-6

- For Low Voltage / Low Current Applications
- For Oscillators up to 3.5GHz and Pout > 10dBm
- For Low Noise Amplifiers
- Low Noise Figure TR1 and TR2 of 1.0 dB at 1.8GHz

- High Current Capability and Low Noise Figure for Wide Dynamic Range Applications
- Ideal for Low Phase Noise Oscillators up to 3.5GHz
- Low Voltage Operation
- Low Noise Figure TR1 and TR2 of 1.1dB at 1.8GHz

- For Low Voltage / Low Current Applications
- For Oscillators up to 3.5GHz and Pout > 10dBm
- Low Noise Amplifiers
- TR1 NF = 1.0dB at 1.8GHz
- TR2 NF = 1.1dB at 1.8GHz

TSLP-6-1 Package

Footprint 1.2 x 0.8 x 0.4mm only!
### 23GHz $f_T$ Single & Twin RF Transistors in TSLP

VCO and RF Modules

> RF Discretes > RF Transistors

- SINGLE and TWIN Type 23GHz Low Phase Noise RF-Transistors in Ideal for Oscillators and VCOs Modules
- High gain (~17dB@1.8GHz), low noise (~1.1dB @1.8GHz)
- 6-Pin Thin Small Leadless Package TSLP-6

<table>
<thead>
<tr>
<th>Transistor</th>
<th>Package</th>
<th>$f_T$ [GHz]</th>
<th>$V_{CE0}$ [V]</th>
<th>$I_{C_{max}}$ [mA]</th>
<th>$G_m$ [dB]</th>
<th>NF [dB]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SINGLE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>BFR460L3</em></td>
<td>TSLP-3-1</td>
<td>23</td>
<td>4.5</td>
<td>35</td>
<td>17</td>
<td>1,1</td>
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<td></td>
</tr>
</tbody>
</table>

| **TWIN**   |             |             |               |                   |           |        |
| BFS460L6   | TSLP-6-1 (1208) | 23          | 4.5           | 35                | 17        | 1,1    |
| T1 (*BFR460) |             |             |               |                   |           |        |
| T2 (*BFR460) |             |             |               |                   |           |        |
| BFS466L6   | TSLP-6-1 (1208) | 23          | 4.5           | 35                | 17        | 1,1    |
| T1 (*BFR460) |             |             |               |                   |           |        |
| T2 (BFR360) |             |             |               |                   |           |        |
| BFS469L6   | TSLP-6-1 (1208) | 23          | 4.5           | 35                | 17        | 1,1    |
| T1 (*BFR460) |             |             |               |                   |           |        |
| T2 (BFR949) |             |             |               |                   |           |        |

*ESD Performance Typ. 1500V HBM*
BFP460, BFP540ESD „EHRT“ ESD-Hardened RF Transistor

- Excellent general-purpose RF transistor from VHF to 2.5 GHz
- Survive 1500V, *1000V Electro-Static Discharge Pulses (Human Body Model) between any pair of terminals
- Unmatched combination of ESD-Robustness and RF performance
- Industry-standard SOT343 package
RF Remote Systems (ISM Based)
ESD Hardened RF-Transistors BFP460, BFP540ESD

> RF Discretes > RF Transistors

**Target Application:**
Industrial Security and ISM based RF Systems (315/433/868MHz) e.g.
- RF Remote On/Off Power Sockets
- RF Remote Garage Door Opener
- RF Security / Alarm

**Product features & USP:**
Unmatched combination of RF Performance with integrated ESD Protection up to 1.5kV (HBM)

**Market Driver:**
Convenience and reliability

**Customer expectations:**
ESD protection, RF Performance, Low Cost, high Quality

**IFX product strategy**
Extended Antenna Range in package with IFX RKE ICs (TDA52xx)

- LNA Boost significantly the sensitivity of RKE ICs
- Easy Set-Up – No SMD Coils Required
- Low Current Operation – Extend Battery Life
- Application Kit/Note No.084 available

![Image of BFP460 and BFP540ESD components]
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- **RF Discretes**
  - Introduction
- **RF Transistors**
- **RF MMICs**
- **RF Diodes**
- **RF PIN Diodes**
- **RF Varactor Diodes**
- **RF Mosfet**
Si MMICs and RF Transistors
Difference in Applications

> RF Discretes > RF MMICs

- Application Specific
  - Often: bias point fixed
  - Narrow Band $f = 1.8 \ldots 6$ GHz
  - Easiest Circuit & Board Design
  - Low Parts Count

- Universal Application
  - Broadband $f = DC \ldots 10$ GHz
  - Best Gain & NF
  - Higher Parts Count
Si MMICs – Why?
Integrated Functions in one Package

> RF Discretes > RF MMICs

The function blocks include:
- active biasing circuit with bandgap
- input-/output matching
- multiple stage/band/gain stage LNA
- ESD protection circuit
- Bipolar Logic
- balun for mode conversion
- Linearity improvement circuit
- booster circuit

→ Customer Benefit: shorter R&D time & cost down
BGA615L7
GPS (1.575GHz) and L-Band SiGe LNA

> RF Discretes > RF MMICs

**Features**

- High Gain 18 dB
- Low Noise Figure 0.9 dB
- Off-mode
- 1KV ESD Protection
- Output 50 \( \Omega \) matched
- Low Parts Count

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS21I₂</td>
<td>Insertion Power Gain</td>
<td>dB</td>
<td>18</td>
</tr>
<tr>
<td>NF</td>
<td>Noise Figure</td>
<td>dB</td>
<td>0.9</td>
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<tr>
<td>OP1dB</td>
<td>Output Compression Point</td>
<td>dBm</td>
<td>6</td>
</tr>
<tr>
<td>OIP3</td>
<td>Output Third Order Intercept Point</td>
<td>dBm</td>
<td>17</td>
</tr>
<tr>
<td>Id</td>
<td>Total Device Current</td>
<td>mA</td>
<td>6</td>
</tr>
</tbody>
</table>

Vcc = 2.8V, frequency = 1.575GHz
BGA622L7
Universal SiGe LNA

> RF Discretes > RF MMICs

Applications
- UMTS / CDMA
- GSM / TDMA / EDGE
- GPS / ISM
- Bluetooth
- DVB-T/DVB-H

Features
- 1.1dB Noise Figure @1.575 GHz
- On-Off Switch
- 50 matched @ > 2 GHz
- Low Parts Count

Now ESD-Proof. 2KV acc. to HBM

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS21I^2</td>
<td>Insertion Power Gain</td>
<td>dB</td>
<td>17.5</td>
</tr>
<tr>
<td>NF</td>
<td>Noise Figure</td>
<td>dB</td>
<td>1.1</td>
</tr>
<tr>
<td>OP1dB</td>
<td>Output Compression Point</td>
<td>dBm</td>
<td>-1</td>
</tr>
<tr>
<td>IP3 out</td>
<td>Output Third Order Intercept Point</td>
<td>dBm</td>
<td>17</td>
</tr>
<tr>
<td>Id</td>
<td>Total Device Current</td>
<td>mA</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Vcc = 2.7V, frequency = 1.575GHz
Applications
- UMTS / CDMA
- GSM / TDMA / EDGE
- GPS / ISM
- Bluetooth
- DVB-T/DVB-H

Features
- 1.1 dB Noise Figure @ 2.1 GHz
- On-Off Switch
- 50 matched @ > 2 GHz
- Low Parts Count

Now ESD-Proof. 2KV acc. to HBM

See App Note 069 for GPS!

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS21</td>
<td>^2</td>
<td>Insertion Power Gain</td>
<td>dB</td>
</tr>
<tr>
<td>NF</td>
<td>Noise Figure</td>
<td>dB</td>
<td>1.1</td>
</tr>
<tr>
<td>P1dB</td>
<td>Output Compression Point</td>
<td>dBm</td>
<td>0</td>
</tr>
<tr>
<td>IP3 out</td>
<td>Third Order Intercept Point</td>
<td>dBm</td>
<td>18</td>
</tr>
<tr>
<td>Id</td>
<td>Total Device Current</td>
<td>mA</td>
<td>5.8</td>
</tr>
</tbody>
</table>
**Features and Benefits**
- For GSM 900/1800/1900 & GPS
- Low NF and high gain
- 50 matched input & output
- Reduced component count
- SOT363 package

### Symbol Parameter Table

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gma</td>
<td>Power Gain</td>
<td>dB</td>
<td>20</td>
</tr>
<tr>
<td>NF</td>
<td>Noise Figure</td>
<td>dB</td>
<td>1.4</td>
</tr>
<tr>
<td>P1dB</td>
<td>Input Compression Point</td>
<td>dBm</td>
<td>-19</td>
</tr>
<tr>
<td>IIP3</td>
<td>Input Third Order Intercept Point</td>
<td>dBm</td>
<td>-9</td>
</tr>
<tr>
<td>Id</td>
<td>Total Device Current</td>
<td>mA</td>
<td>8,2</td>
</tr>
</tbody>
</table>
BGA700L16, Dual Band WLAN LNA

> RF Discretes > RF MMICs

Bare Die Sales Code: T1515
Package Sales Code: BGA700L16

P. Size: 2.3 x 2.3 x 0.39 mm³

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Gain</th>
<th>Noise Figure</th>
<th>IP-1dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4 GHz</td>
<td>15 dB</td>
<td>0.9 dB</td>
<td>-10 dB</td>
</tr>
<tr>
<td>5.5 GHz</td>
<td>21 dB</td>
<td>1.3 dB</td>
<td>-10 dB</td>
</tr>
</tbody>
</table>
BGA612, BGA614, BGA616
SiGe Broadband Amplifier / DC ... 5GHz, 50 matched

> RF Discretes > RF MMICs

Applications
- Supply Voltage > 3 V
- Driver Amp for GSM / EDGE / CDMA
- SAT LNB IF amplifiers
- CATV Amplifiers
- ISM and Bluetooth
- Cellular Base Stations
- DVB-T Amplifier

Application support see application note 067!

### Table: Maximum Ratings and Characteristics

<table>
<thead>
<tr>
<th>Type</th>
<th>Maximum Ratings</th>
<th>Characteristics</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Device Voltage</td>
<td>3dB Gain IS21</td>
<td>Output Power</td>
</tr>
<tr>
<td></td>
<td>[V]</td>
<td>[dB]</td>
<td>[dBm]</td>
</tr>
<tr>
<td>BGA 612</td>
<td>2.8</td>
<td>2.8</td>
<td>15.8</td>
</tr>
<tr>
<td>BGA 614</td>
<td>3.0</td>
<td>2.4</td>
<td>17.1</td>
</tr>
<tr>
<td>BGA 616</td>
<td>4.5</td>
<td>2.7</td>
<td>17.5</td>
</tr>
</tbody>
</table>
Features
- High Performance:
  - Gain=13 dB *
  - NF=2.2 dB *
  - Reverse isolation > 28 dB *
  - OIP3 = +10 dBm *
- Input/output matched
  * data @ 3 V, 6.4 mA ; 1800 MHz

Benefits
- SOT343
- Easy to design in

Gain [dB]

<table>
<thead>
<tr>
<th>Freq [GHz]</th>
<th>0.1</th>
<th>0.2</th>
<th>0.5</th>
<th>0.8</th>
<th>1.0</th>
<th>3.0</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain [dB]</td>
<td>25</td>
<td>22</td>
<td>20</td>
<td>18</td>
<td>15</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>
BGA427
Broadband LNA-MMIC in SIEGET®25 Technology

> RF Discretes > RF MMICs

Features
- High Performance
- Gain=22 dB *
- NF=2.2 dB *
- Reverse isolation > 35 dB *
- IP3output = +7 dBm *
- Input/output matched
  * data @ 3 V, 6.4 mA; 1800 MHz

Benefits
- SOT343
- Easy to design in

Gain [dB]

<table>
<thead>
<tr>
<th>Freq [GHz]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
</tr>
<tr>
<td>25</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>RF Discretes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
</tr>
<tr>
<td>RF Transistors</td>
</tr>
<tr>
<td>RF MMICs</td>
</tr>
<tr>
<td>RF Diodes</td>
</tr>
<tr>
<td>RF PIN Diodes</td>
</tr>
<tr>
<td>RF Varactor Diodes</td>
</tr>
<tr>
<td>RF Mosfet</td>
</tr>
</tbody>
</table>
RF Diodes Packages and Configurations

> RF Discretes > RF Diodes

SC79-02V  
SCD80-02W  
SOD323-03W  
TSLP-2/RH-02L/RH  
TSSLP-02LS  

SOT23-04  
SOT323-04W  
SOT23-05  
SOT323-05W  
SOT23-06  
SOT323-06W  
TSLP-3/RH-03L/RH  

SOT143-099  
TSLP-4-099L  
TSLP-4-098L  

SOT363-08S  
SOT363-04S  
SOT143-099  

Example
BAR63-03W  
Single Diode in SOD323  
BAR63-04W  
Double Diode, seriell configuration in SOT323
<table>
<thead>
<tr>
<th>RF Discretes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
</tr>
<tr>
<td>RF Transistors</td>
</tr>
<tr>
<td>RF MMICs</td>
</tr>
<tr>
<td>RF Diodes</td>
</tr>
<tr>
<td>RF PIN Diodes</td>
</tr>
<tr>
<td>RF Varactor Diodes</td>
</tr>
<tr>
<td>RF Mosfet</td>
</tr>
</tbody>
</table>
PIN Diodes Applications & Key Parameters

Band switching in TV / SAT tuners
Antenna switching in RF Frontends
RF attenuator
Surge Protection

$t_{rr}$ Charge carrier lifetime
$\text{Switching time}$

$r_f$ Forward resistance
Low for low insertion loss

$C_T$ Diode capacitance
Small for high isolation
Diode packages for smallest size

> RF Discretes > RF PIN Diodes

**TSLP**
- TSLP-2/3/4
- Package Height: 0.50 mm max.
- 1.0 x 0.6 x 0.4 mm / 1.2 x 0.8 x 0.4 mm

**TSLP-RH**
- TSLP-2/3/4-RH
- Reduced Height: 0.40 mm max.
- 1.0 x 0.6 x 0.39 mm / 1.2 x 0.8 x 0.39 mm

**TSSLP**
- TSSLP-2
- Package Height: 0.32 mm max.
- 0.6 x 0.3 x 0.31 mm

2003

2004

2005

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PIN Diodes for Antenna Switches @ 900MHz

> RF Discretes > RF PIN Diodes

**Insertion loss (@ 900 MHz)**

Series configuration, $Z_L = 50$

**BAR 50-02V/L**

- Ins. loss 0.27 dB @ 10 mA
- Isolation 24.5 dB @ 0 V

**BAR 64-02V/LRH**

- Ins. loss 0.16 dB @ 10 mA
- Isolation 22 dB @ 0 V

**BAR 63-02V/L**

- Ins. loss 0.10 dB @ 10 mA
- Isolation 17.9 dB @ 0 V

**BAR 65-02V/L**

- Ins. loss 0.05 dB @ 10 mA
- Isolation 12 dB @ 0 V

**BAR 88-02V/LRH**

- Ins. loss 0.06 dB @ 10 mA
- Isolation 15.5 dB @ 0 V

**BAR 89-02LRH**

- Ins. loss 0.08 dB @ 10 mA
- Isolation 19 dB @ 0 V

**BAR 90-02LRH/LS**

- Ins. loss 0.08 dB @ 10 mA
- Isolation 19 dB @ 0 V

**BAR 90: improved insertion loss towards lower current**

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PIN Diodes for Antenna Switches @1800MHz

> RF Discretes > RF PIN Diodes

**Insertion loss** (@ 1800 MHz)

Series configuration, $Z_L = 50$ Ohm
IF = 5 mA, VR = 0V

<table>
<thead>
<tr>
<th>Device</th>
<th>Insertion Loss</th>
<th>Isolation @ 0V</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAR 50-02V/L</td>
<td>0.7 dB</td>
<td>11 dB</td>
</tr>
<tr>
<td>BAR 64-02V/LRH</td>
<td>0.6 dB</td>
<td>17 dB</td>
</tr>
<tr>
<td>BAR 65-02V/L</td>
<td>0.6 dB</td>
<td>7 dB</td>
</tr>
<tr>
<td>BAR 88-02V/LRH</td>
<td>0.7 dB</td>
<td>11 dB</td>
</tr>
<tr>
<td>BAR 90-02LRH/LS</td>
<td>0.1 dB</td>
<td>13.5 dB</td>
</tr>
</tbody>
</table>

BAR 90: improved insertion loss towards lower current
Dual PIN Diodes for Antenna Switches in TSLP-4 @ 900MHz

> RF Discretes > RF PIN Diodes

Series configuration, $Z_L=50\Omega$
IF= 10mA, VR= 0V

Insertion loss (@ 900 MHz)

- **BAR 88-07LRH/099LRH**
  - Ins. loss: 0.07 dB @ 10mA
  - Isolation: 15.5 dB @ 0V

- **BAR 65-07 L**
  - Ins. loss: 0.05 dB @ 10mA
  - Isolation: 12 dB @ 0V

- **BAR 90-07LRH/-098LRH/099LRH**
  - Ins. loss: 0.07 dB @ 10mA
  - Isolation: 19 dB @ 0V

Isolation (@ 900 MHz)
Diodes in TSLP-4 Package

> RF Discretes > RF PIN Diodes

Dual Diodes in **parallel** and **anti-parallel** configuration

**Advantage for customer:**
40% footprint reduction compared to 2 single diodes

<table>
<thead>
<tr>
<th>PIN Diodes</th>
<th>Schottky Diodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAR88-07LRH</td>
<td>BAT15-07LRH</td>
</tr>
<tr>
<td>BAR90-07LRH</td>
<td>BAT62-07L4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PIN Diodes</th>
<th>Schottky Diodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAR88-098LRH</td>
<td>BAT15-098LRH</td>
</tr>
<tr>
<td>BAR88-099LRH</td>
<td>BAT15-099LRH</td>
</tr>
<tr>
<td>BAR90-098LRH</td>
<td>BAT90-098LRH</td>
</tr>
<tr>
<td>BAR90-099LRH</td>
<td>BAT90-099LRH</td>
</tr>
</tbody>
</table>

TSLP-4/TSLP-4-RH
1,2x0,8x0,5/0,4mm
PIN Diodes Harmonic Distortion Values

> RF Discretes > RF PIN Diodes

<table>
<thead>
<tr>
<th>Type</th>
<th>2nd / 3rd Harmonics (dBc), typical values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>35 dBm, 900 MHz, 50 Ohm, single diode in series configuration</td>
</tr>
<tr>
<td></td>
<td>IF= 1 mA</td>
</tr>
<tr>
<td>BA 892-...</td>
<td>60 / 60</td>
</tr>
<tr>
<td>BAR 50-...</td>
<td>na *)</td>
</tr>
<tr>
<td>BAR 63-...</td>
<td>na *)</td>
</tr>
<tr>
<td>BAR 64-...</td>
<td>na *)</td>
</tr>
<tr>
<td>BAR 65-...</td>
<td>40 / 40</td>
</tr>
<tr>
<td>BAR 67-...</td>
<td>30 / 30</td>
</tr>
<tr>
<td>BAR 88-...</td>
<td>70 / 75</td>
</tr>
<tr>
<td>BAR 89-...</td>
<td>40 / 40</td>
</tr>
<tr>
<td>BAR 90-...</td>
<td>65 / 65</td>
</tr>
</tbody>
</table>

* Not applicable, restricted by max. power dissipation of diode

Noise floor of used test setup: 95 dBc
Harmonic Distortion BAR88 / 89 / 90 series

> RF Discretes > RF PIN Diodes

Switching PIN diode BAR88 / BAR89 / BAR90 series

2nd Harmonic distortion performance
Test conditions: Pin = 35 dBm (ON mode) / 0 dBm (OFF mode), fo = 900 MHz, Z = 50 Ohm

BAR90 with balanced harmonic performance in 'On' and 'Off' modes!
PIN Diodes Line Up for FM and TV Tuners

> RF Discretes > RF PIN Diodes

**Key Features**
- Very low capacitance and forward resistance values to guarantee:
  - Low harmonic for band-switching and antenna-switching applications
  - Low distortion factor for RF attenuation applications
  - Long-term stability of electrical characteristics

<table>
<thead>
<tr>
<th>Type</th>
<th>package</th>
<th>Ct@1V</th>
<th>rf@10mA</th>
<th>Trr</th>
<th>Appl.</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA592</td>
<td>SOD323</td>
<td>0.92 pF</td>
<td>0.36 Ohm</td>
<td>120 ns</td>
<td>Band switching</td>
</tr>
<tr>
<td></td>
<td>SCD80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SC79</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TSLP2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA892</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA892-02V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA892-02L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA595</td>
<td>SOD323</td>
<td>0.35 pF</td>
<td>4.5 Ohm</td>
<td>1.6 us</td>
<td>RF attenuation</td>
</tr>
<tr>
<td></td>
<td>SOT23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SCD80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA885</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA895</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BAR14-1, BAR15-1, BAR16-1 (Dual)</td>
<td>SOT23</td>
<td>0.50 pF</td>
<td>7.0 Ohm</td>
<td>1.0 us</td>
<td>RF attenuation</td>
</tr>
<tr>
<td>BAR50-02V</td>
<td>SC79</td>
<td>0.24 pF</td>
<td>3.0 Ohm</td>
<td>1.1 us</td>
<td>RF attenuation</td>
</tr>
<tr>
<td>BAR61 (Triple)</td>
<td>SOT143</td>
<td>0.25 pF</td>
<td>7.0 Ohm</td>
<td>1.0 us</td>
<td>RF attenuation</td>
</tr>
</tbody>
</table>
## PIN Diodes Line up

### > RF Discretes > RF PIN Diodes

<table>
<thead>
<tr>
<th>Type</th>
<th>package</th>
<th>Ct @ 1V</th>
<th>rF @ 10mA</th>
<th>trr</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA592</td>
<td>SOD323</td>
<td>0.92 pF</td>
<td>0.36 Ohm</td>
<td>120 ns</td>
<td>Bd-Sw</td>
</tr>
<tr>
<td>BA892</td>
<td>SC80</td>
<td>0.92 pF</td>
<td>0.36 Ohm</td>
<td>120 ns</td>
<td>Bd-Sw</td>
</tr>
<tr>
<td>BA892-02V</td>
<td>SC79</td>
<td>0.92 pF</td>
<td>0.36 Ohm</td>
<td>120 ns</td>
<td>Bd-Sw</td>
</tr>
<tr>
<td>BA892-02L</td>
<td>TSLP2</td>
<td>0.92 pF</td>
<td>0.36 Ohm</td>
<td>120 ns</td>
<td>Bd-Sw</td>
</tr>
<tr>
<td>BA595</td>
<td>SOD323</td>
<td>0.35 pF</td>
<td>4.5 Ohm</td>
<td>1.6 µs</td>
<td>RF-att</td>
</tr>
<tr>
<td>BA885</td>
<td>SOT23</td>
<td>0.35 pF</td>
<td>4.5 Ohm</td>
<td>1.6 µs</td>
<td>RF-att</td>
</tr>
<tr>
<td>BA895</td>
<td>SC80</td>
<td>0.35 pF</td>
<td>4.5 Ohm</td>
<td>1.6 µs</td>
<td>RF-att</td>
</tr>
<tr>
<td>BAR14-1,15-1,16-1</td>
<td>SOT23</td>
<td>0.50 pF</td>
<td>7.0 Ohm</td>
<td>1.0 µs</td>
<td>RF-att</td>
</tr>
<tr>
<td>BAR50-02V</td>
<td>SC79</td>
<td>0.24 pF</td>
<td>3.0 Ohm</td>
<td>1.1 µs</td>
<td>Ant.-sw</td>
</tr>
<tr>
<td>BAR50-02L</td>
<td>TSLP2</td>
<td>0.24 pF</td>
<td>3.0 Ohm</td>
<td>1.1 µs</td>
<td>Ant.-sw</td>
</tr>
<tr>
<td>BAR63-03W</td>
<td>SOD323</td>
<td>0.23 pF</td>
<td>1.0 Ohm</td>
<td>75 ns</td>
<td>Ant.-sw</td>
</tr>
<tr>
<td>BAR63-02W</td>
<td>SC80</td>
<td>0.23 pF</td>
<td>1.0 Ohm</td>
<td>75 ns</td>
<td>Ant.-sw</td>
</tr>
<tr>
<td>BAR63-02V</td>
<td>SC79</td>
<td>0.23 pF</td>
<td>1.0 Ohm</td>
<td>75 ns</td>
<td>Ant.-sw</td>
</tr>
<tr>
<td>BAR63-02L</td>
<td>TSLP2</td>
<td>0.23 pF</td>
<td>1.0 Ohm</td>
<td>75 ns</td>
<td>Ant.-sw</td>
</tr>
<tr>
<td>BAR63-04/05/06 (D)</td>
<td>SOT23</td>
<td>0.23 pF</td>
<td>1.0 Ohm</td>
<td>75 ns</td>
<td>Ant.-sw</td>
</tr>
<tr>
<td>BAR63-04W/05W/06W</td>
<td>SOT323</td>
<td>0.23 pF</td>
<td>1.0 Ohm</td>
<td>75 ns</td>
<td>Ant.-sw</td>
</tr>
<tr>
<td>BAR64-03W</td>
<td>SOD323</td>
<td>0.45 pF</td>
<td>2.1 Ohm</td>
<td>1.55 µs</td>
<td>Ant.-sw</td>
</tr>
<tr>
<td>BAR64-02V</td>
<td>SC79</td>
<td>0.45 pF</td>
<td>2.1 Ohm</td>
<td>1.55 µs</td>
<td>Ant.-sw</td>
</tr>
<tr>
<td>BAR64-02LRH</td>
<td>TSLP2-RH</td>
<td>0.45 pF</td>
<td>2.1 Ohm</td>
<td>1.55 µs</td>
<td>Ant.-sw</td>
</tr>
<tr>
<td>BAR64-04/05/06/07</td>
<td>SOT323</td>
<td>0.45 pF</td>
<td>2.1 Ohm</td>
<td>1.55 µs</td>
<td>Ant.-sw</td>
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<td>BAR64-04W/05W/06W</td>
<td>SOT323</td>
<td>0.45 pF</td>
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<td>1.55 µs</td>
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<td>BAR65-03W</td>
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<td>0.45 pF</td>
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<td>Ant.-sw</td>
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<td>BAR65-02V</td>
<td>SC79</td>
<td>0.45 pF</td>
<td>0.6 Ohm</td>
<td>80 ns</td>
<td>Ant.-sw</td>
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<tr>
<td>BAR66</td>
<td>SOT23</td>
<td>0.45 pF</td>
<td>1.0 Ohm</td>
<td>700 ns</td>
<td>surge</td>
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<tr>
<td>BAR67-02V</td>
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<td>1.0 Ohm</td>
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<td>BAR691</td>
<td>SOT143</td>
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<td>1.0 µs</td>
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<td>BAR888-02V</td>
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<td>0.3 pF</td>
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<td>BAR888-02LRH,-07LRH,-098LRH,099LRH</td>
<td>TSLP2-RH, TSLP4-RH</td>
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<td>BAR889-02LRH</td>
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<td>BAR90-02L5</td>
<td>TSSLP2</td>
<td>0.25 pF</td>
<td>0.8 Ohm</td>
<td>0.75 µs</td>
<td>Ant.-sw</td>
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<tr>
<td>BAR90-02LRH,-07LRH,-099LRH</td>
<td>TSLP2-RH, TSLP4-RH</td>
<td>0.25 pF</td>
<td>0.8 Ohm</td>
<td>0.75 µs</td>
<td>Ant.-sw</td>
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<td>Table of Contents</td>
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<td>RF Discretes</td>
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<td>RF PIN Diodes</td>
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<td>RF Varactor Diodes</td>
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<td>RF Mosfet</td>
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Varactor Diodes Applications & Key Parameters

> RF Discretes > RF Varactor Diodes

<table>
<thead>
<tr>
<th>Tuned Filter</th>
<th>Varactor Diodes</th>
<th>UHF / VHF Tuner</th>
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<tr>
<td>VCO Application</td>
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<td>SAT Tuner</td>
</tr>
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<td></td>
<td></td>
<td>FM Tuner</td>
</tr>
</tbody>
</table>

- $C_{V_{\text{min}}}/C_{V_{\text{max}}}$
- $r_s$
- Capacitance ratio
- Series resistance
- Indicates tuning range
- Indicates Q factor
- Influence on phase noise
Varactor Diodes Product Portfolio

> RF Discretes > RF Varactor Diodes

- VCO and Low Voltage Tuner
  - Tuner
    - BB535, BB545, BB555/-02V, BB565/-02V
    - BB639, BB639C, BB659, BB659C/-02V, BB644, BB664/-02V, BB689/-02V, BB640
    - BB804, BB814, BB914, BB844
  - BBY5x-series
  - BBY6x-series

- FM
  - 300 MHz
  - 1 GHz
  - 3 GHz
  - 5 GHz

- WLAN
- Bluetooth
- Cellular
- Satellite
- GSM
- UHF
- Cordless Phones
- VHF

1.8 V  4 V  10 V  28 V
## Varactor Diodes Line Up for VCOs

> RF Discretes > RF Varactor Diodes

<table>
<thead>
<tr>
<th>Type</th>
<th>Package</th>
<th>C@1V</th>
<th>Cap-ratio</th>
<th>rs (Ohm)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BBY51-03W, 02W, 02L</td>
<td>SOD323, SCD80, TSLP2</td>
<td>5.4pF</td>
<td>1.75 (1V/3V)</td>
<td>0.37</td>
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<tr>
<td>BBY51</td>
<td>SOT23</td>
<td>5.4pF</td>
<td>1.75 (1V/3V)</td>
<td>0.37</td>
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<tr>
<td>BBY52-02W, 02L</td>
<td>SCD80, TSLP2</td>
<td>1.9pF</td>
<td>1.6 (1V/4V)</td>
<td>0.9</td>
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<tr>
<td>BBY53-03W,02W, 02V</td>
<td>SOD323, SCD80, SC79</td>
<td>5.3pF</td>
<td>2.2 (1V/3V)</td>
<td>0.47</td>
<td></td>
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<tr>
<td>BBY53, -05W</td>
<td>SOT23, SOT323</td>
<td>5.3pF</td>
<td>2.2 (1V/3V)</td>
<td>0.47</td>
<td>Double</td>
</tr>
<tr>
<td>BBY53-02L, 03LRH</td>
<td>TSLP2, TSLP3-RH</td>
<td>5.3pF</td>
<td>2.2 (1V/3V)</td>
<td>0.47</td>
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<tr>
<td>BBY55-02W,02V</td>
<td>SCD80,SC79</td>
<td>18.6pF</td>
<td>2.5 (2V/10V)</td>
<td>0.15</td>
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<tr>
<td>BBY55-03W</td>
<td>SOD323</td>
<td>18.6pF</td>
<td>2.5 (2V/10V)</td>
<td>0.15</td>
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<tr>
<td>BBY56-02W</td>
<td>SCD80</td>
<td>40pF</td>
<td>2.6 (1V/3V)</td>
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<tr>
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<td>SOD323</td>
<td>40pF</td>
<td>2.6 (1V/3V)</td>
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<tr>
<td>BBY57-02W,02V</td>
<td>SCD80,SC79</td>
<td>17.5pF</td>
<td>2.45 (1V/3V)</td>
<td>0.3</td>
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<tr>
<td>BBY57-02L</td>
<td>TSLP2</td>
<td>17.5pF</td>
<td>2.45 (1V/3V)</td>
<td>0.35</td>
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<tr>
<td>BBY57-05W</td>
<td>SOT323</td>
<td>17.5pF</td>
<td>2.45 (1V/3V)</td>
<td>0.3</td>
<td>Double</td>
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<tr>
<td>BBY58-03W, 02W,02V</td>
<td>SOD323, SCD80, SC79</td>
<td>18.3pF</td>
<td>3.05 (1V/4V)</td>
<td>0.25</td>
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<tr>
<td>BBY58-02L</td>
<td>TSLP2</td>
<td>18.3pF</td>
<td>3.05 (1V/4V)</td>
<td>0.3</td>
<td>Double</td>
</tr>
<tr>
<td>BBY58-05W, 06W</td>
<td>SOT323</td>
<td>18.3pF</td>
<td>3.05 (1V/4V)</td>
<td>0.25</td>
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<tr>
<td>BBY59-02V</td>
<td>SC79</td>
<td>28pF</td>
<td>4 (1V/4V)</td>
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<td>BBY65-02V</td>
<td>SC79</td>
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<td>4.55 (1V/3V)</td>
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<tr>
<td>BBY66-02V</td>
<td>SC79</td>
<td>70pF</td>
<td>5.5 (1V/4,5V)</td>
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<tr>
<td>BBY66-05, 05W</td>
<td>SOT23, SOT323</td>
<td>70pF</td>
<td>5.5 (1V/4,5V)</td>
<td>0.25</td>
<td>Double</td>
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### Varactor Diodes Product Overview
for FM/TV/SAT Tuner

> RF Discretes > RF Varactor Diodes

<table>
<thead>
<tr>
<th>Type</th>
<th>package</th>
<th>C@2V</th>
<th>C_0/C_2</th>
<th>r_s</th>
<th>Appl.</th>
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<tbody>
<tr>
<td>BB804 (Dual)</td>
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<td>45pF</td>
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<td>0.2 Ohm</td>
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<td>BB814 (Dual)</td>
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<td>46pF</td>
<td>2.15</td>
<td>0.2 Ohm</td>
<td>FM</td>
</tr>
<tr>
<td>BB844</td>
<td>SOT23</td>
<td>45pF</td>
<td>3.5</td>
<td>0.3 Ohm</td>
<td>FM</td>
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<tr>
<td>BB914 (Dual)</td>
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<td>45 pF</td>
<td>2.35</td>
<td>0.28 Ohm</td>
<td>FM</td>
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<table>
<thead>
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<th>Type</th>
<th>package</th>
<th>C@1V</th>
<th>C_0/C_1</th>
<th>r_s</th>
<th>Appl.</th>
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<tbody>
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<td>BB639</td>
<td>SOD323</td>
<td>38pF</td>
<td>14.7</td>
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<tr>
<td>BB659</td>
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<td>BB639C</td>
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<td>BB659C, BB659C-02V</td>
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<td>0.6 Ohm</td>
<td>VHF</td>
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<td>BB644</td>
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<td>BB669</td>
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<td>BB689, BB689-02V</td>
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<td>BB535</td>
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<td>BB555, BB555-02V</td>
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<td>BB565, BB565-02V</td>
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<td>10.0</td>
<td>0.6 Ohm</td>
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<td>BB831</td>
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<td>1.3 Ohm</td>
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<td>BB833</td>
<td>SOD323</td>
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<td>12.4</td>
<td>1.8 Ohm</td>
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<td>BB837</td>
<td>SOD323</td>
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<td>SC80</td>
<td>6.6pF</td>
<td>12.0</td>
<td>1.8 Ohm</td>
<td>SAT</td>
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</table>
Low voltage Varactor Diodes
for T-DMB and DVB-H Tuners

> RF Discretes > RF Varactor Diodes

Capacitance value @ 1V

70 pF

50 pF

30 pF

10 pF

1.0

2.0

3.0

4.0

5.0

Capacitance ratio

BBY65-02V
C1V / C3V=4.55
rs @ 1 V = 0.60Ohm

BBY56-xx
C1V / C3V=2.5
rs @ 1 V = 0.25Ohm

BBY58-xx
C1V / C3V=2.15
rs @ 1 V = 0.25Ohm

BBY55-xx
C2V / C10V=2.5
rs @ 5 V = 0.15Ohm

BBY53-xx
C1V / C3V=2.2
rs @ 1 V = 0.47Ohm

50 pF

30 pF

10 pF

Capacitance value @ 1V
## Table of Contents

- **RF Discretes**
  - Introduction
  - RF Transistors
  - RF MMICs
  - RF Diodes
  - RF PIN Diodes
  - RF Varactor Diodes
  - RF Mosfet
RF MOSFET: Single and Dual Gain controlled prestage amplifier for analog & digital TV/ VCR/ DVD/ STB Tuner

> RF Discretes > RF Mosfet

- BG3130/R
- BG3123/R
- BG5130R
- BG3430R*
- BF2030x
- BF2040x
- BF5030W
- 4 x BB565
- 4 x BB659C
- 4 x BB689
- MOPLL IC
- Port/ADC
- 4 Ports
- I2C Bus
- to SWF

* BG3430R: for two band tuners
**DualMOS : Two MOSFETs in One package**

> RF Discretes > RF Mosfet

**Applications**

- Analog and digital tuner modules
- More than 50% of footprint saving compared to 2 single MOSFETs
- Less pick and place effort
- Easier Logistics
- Price advantage than 2 x single MOSFET

**SOT343 Outline:**

(L x W x H) 2*1.25*0.9 mm³

**SOT363 Outline:**

(L x W x H) 2*1.25*0.9 mm³
## DualMOS Product Portfolio

### > RF Discretes > RF Mosfet

### PNP Switched

<table>
<thead>
<tr>
<th>Bias Type</th>
<th>Device Code</th>
<th>Parameters</th>
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</thead>
<tbody>
<tr>
<td>Semi Biased</td>
<td>BG3123 / R</td>
<td>$G_{psA}/G_{psB} = 25/24$ dB, $F_A / F_B = 1.8/1.8$ dB, $C_{g1ssA}/C_{dssA} = 1.9/1.3$ pF, $C_{g1ssB}/C_{dssB} = 1.5/1.1$ pF</td>
</tr>
<tr>
<td>Full Biased</td>
<td>BG3130 / R</td>
<td>$G_{ps} = 24$ dB, $F = 1.3$ dB, $C_{g1ss}/C_{dss}=1.9/1.1$ pF</td>
</tr>
<tr>
<td>Semi / Full Biased</td>
<td>BG3430R</td>
<td>$G_{ps} = 25$ dB, $F = 1.7$ dB, $C_{g1ss}/C_{dss} = 1.9/1.1$ pF</td>
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</table>

### NPN Switched

<table>
<thead>
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<th>Device Code</th>
<th>Parameters</th>
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</thead>
<tbody>
<tr>
<td>Full Biased</td>
<td>BG3230 / R</td>
<td>$G_{ps} = 25.5$ dB, $F = 1.3$ dB, $C_{g1ss}/C_{dss} = 1.9/1.1$ pF</td>
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</tbody>
</table>

### Package for all types: SOT363
BG3430R
First intelligent-switching dualMOS

> RF Discretes > RF Mosfet

**Target applications:**
- 2 or 2.5 band tuners e.g. for DVB-T

**Supporting Tools:**
- Datasheet and Simulation Data

---

**Key Features**
- FET A with partly integrated biasing resistor network
- FET B with fully integrated biasing resistor network
- Only one switching pin (G1A) to control two MOSFETs simultaneously, at anytime there is always one FET switched on
  - $V_{GG} = 5V$, FET A **ON**, FET B **OFF**
  - $V_{GG} = 0V$, FET A **OFF**, FET B **ON**
- in SOT363 package

---

**Performance Data**
- $G_{fsA} = G_{fsB} = 33mS$
- $C_{gss} = 1.8pF$
- $C_{dss} = 1.3pF$
- $NF @ 3V, 10mA, 800MHz = 1.2dB$
- $NF @ 3V, 10mA, 45MHz = 0.7dB$
- System ESD Class 2 (2kV – 4kV)
BG3430R – RF DualMOS with Intelligent Switching
Layout advantage

> RF Discretes > RF Mosfet

- Application: 2 or 2.5 band tuners
- FET A semi-integrated biasing network, Gfs=24mS
  FET B fully-integrated biasing network, Gfs=30mS
- Only ONE switching line to switch on/off both MOS (PNP Port)
- Switching @ Pin 1, FET A Gate 1

Switching matrix

<table>
<thead>
<tr>
<th>V_{GG}</th>
<th>FET A</th>
<th>FET B</th>
</tr>
</thead>
<tbody>
<tr>
<td>5V</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>0V</td>
<td>Off</td>
<td>On</td>
</tr>
</tbody>
</table>

Tuner layout is very high packed
Switching line from PNP port must be lead from tuner IC to MOSFET
If only one line has to be designed
  → Saves PCB area and 1 control port tuner
  → Saves 1 resistor and 1 capacitor
  → Lower risk of crosstalk, feedback
  → Easier to design RF ground for MOSFET
### SingleMOS Product Portfolio

> RF Discretes > RF Mosfet

<table>
<thead>
<tr>
<th>V&lt;sub&gt;DS&lt;/sub&gt;</th>
<th>External Biasing</th>
<th>Semi Biased</th>
<th>Full Biased</th>
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<tbody>
<tr>
<td>12 V</td>
<td>BF999 Triode</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>G&lt;sub&gt;ps&lt;/sub&gt; = 25 dB</td>
<td>F = 1.0 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C&lt;sub&gt;gss&lt;/sub&gt;/C&lt;sub&gt;dss&lt;/sub&gt; = 2.5/0.9 pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 V</td>
<td>BF998 / R</td>
<td></td>
<td>BF1009S / SR</td>
</tr>
<tr>
<td></td>
<td>G&lt;sub&gt;ps&lt;/sub&gt; = 20 dB</td>
<td>F = 1.0 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C&lt;sub&gt;gss&lt;/sub&gt;/C&lt;sub&gt;dss&lt;/sub&gt; = 2.1/1.2 pF</td>
<td></td>
<td>G&lt;sub&gt;ps&lt;/sub&gt; = 22 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>F = 1.4 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C&lt;sub&gt;gss&lt;/sub&gt;/C&lt;sub&gt;dss&lt;/sub&gt; = 2.1/0.9 pF</td>
</tr>
<tr>
<td>5 V</td>
<td>BF2040 / R / W</td>
<td>BF2030 / R / W</td>
<td>BF1005S / SR</td>
</tr>
<tr>
<td></td>
<td>G&lt;sub&gt;ps&lt;/sub&gt; = 23 dB</td>
<td>F = 1.6 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C&lt;sub&gt;gss&lt;/sub&gt;/C&lt;sub&gt;dss&lt;/sub&gt; = 2.7/1.6 pF</td>
<td></td>
<td>G&lt;sub&gt;ps&lt;/sub&gt; = 20 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>F = 1.4 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C&lt;sub&gt;gss&lt;/sub&gt;/C&lt;sub&gt;dss&lt;/sub&gt; = 2.1/1.3 pF</td>
</tr>
<tr>
<td>3 V</td>
<td>BF5030W</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>G&lt;sub&gt;ps&lt;/sub&gt; = 24 dB</td>
<td>F = 1.3 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C&lt;sub&gt;gss&lt;/sub&gt;/C&lt;sub&gt;dss&lt;/sub&gt; = 2.7/1.6 pF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Package:** SOT23 / SOT143 / SOT143 Reverse / SOT343
BF5030W / BG5130R
Ultra Low Noise, Low Power MOSFETs

> RF Discretes > RF Mosfet

Target applications:
- 5V or 3V tuners requiring superior NF performance

Available types:
- Single semi-biased MOSFET in SOT343 BF5030W
- Dual semi-biased MOSFET in SOT363 BG5130R

Evaluation board of BF5030W available
- For 50MHz/800MHz
- Application Notes on Internet site

Key features:
- Ultra low NF under 5V or 3V supply voltages
- NF more independent from mismatch of tuner module
- Power saving of 40% under 3V supply voltage
- Verified with System ESD Class 2 (2kV – 4kV)
- System solution with Infineon new tuner IC TUA6045/TUA6041/TUA6039

Performance:
- $G_{fs} = 41mS$
- $C_{g1ss} = 2.7pF$
- $C_{dss} = 1.6pF$
- $NF \ @ \ 3V, 10mA, 800MHz = 1.2dB$
- $NF \ @ \ 3V, 10mA, 45MHz = 0.7dB$
- $X_{mod@AGC\ 0} = 94dB$
- $X_{mod@AGC\ 10dB} = 92\ dB$
- $X_{mod@AGC\ 40\ dB} = 98\ dB$
RF MOSFET Biasing Explanation

> RF Discretes > RF Mosfet

**External Biasing**

- Fully integrated biasing network

**Full Biased**

- NPN Port Tuner IC
- DC 5V / 9V
- AGC
- RF Out
- RF In

**Semi Biased**

- PNP Port Tuner IC
- DC
- AGC
- RF Out
- RF In

- Integrated biasing network but external resistor at G1
## Table of Contents

- Applications
- RF Discretes
- **Schottky Diodes**
- HiPAC, TVS Diodes, Silicon Microphone
- LED Drivers
- AF Discretes
- General Information
Schottky Diodes

Requirements
- High efficiency / low loss
- Low Forward voltages VF
- Low leakage current
- Low power consumption
- Low level of signal distortion
- Small packages and more elements /package
## Schottky Diode Portfolio

### Diode Capacitance vs. Forward Voltage

### > Schottky Diodes

<table>
<thead>
<tr>
<th>Series</th>
<th>Product Code</th>
<th>WLAN: 5-6 GHz</th>
<th>WLAN: 2.4 GHz</th>
<th>Mobile phones: 0.8 to 2.1 GHz</th>
<th>Dataline protection (PC, Notebook): 0 to 0.2 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAS70 series</td>
<td>BAS52-02V</td>
<td>BAT68 series</td>
<td>BAS125 series</td>
<td>BAS40 series</td>
<td>BAT165</td>
</tr>
<tr>
<td>BAT17 series</td>
<td>BAT60A</td>
<td>BAS40 series</td>
<td>BAS70 series</td>
<td>BAS125 series</td>
<td>BAT63 series</td>
</tr>
<tr>
<td>BAT68 series</td>
<td>BAS60B</td>
<td>BAS60B</td>
<td>BAS125 series</td>
<td>BAS40 series</td>
<td>BAT165</td>
</tr>
<tr>
<td>BAS3005B-02V</td>
<td>BAT60B</td>
<td>BAS60B</td>
<td>BAS125 series</td>
<td>BAS40 series</td>
<td>BAT165</td>
</tr>
<tr>
<td>BAS30105B-03W</td>
<td>BAT60B</td>
<td>BAS60B</td>
<td>BAS125 series</td>
<td>BAS40 series</td>
<td>BAT165</td>
</tr>
<tr>
<td>BAS30105B-03W</td>
<td>BAT60B</td>
<td>BAS60B</td>
<td>BAS125 series</td>
<td>BAS40 series</td>
<td>BAT165</td>
</tr>
</tbody>
</table>

### Graph

The graph illustrates the relationship between diode capacitance and forward voltage across different frequency ranges:

- **WLAN:** 5-6 GHz
- **WLAN:** 2.4 GHz
- **Mobile phones:** 0.8 to 2.1 GHz
- **Dataline protection (PC, Notebook):** 0 to 0.2 GHz

The graph displays various Schottky diode series and their corresponding capacitance and forward voltage values at different currents (1 mA, 10 mA, 100 mA).

Applications include:
- **WLAN:** 5-6 GHz
- **WLAN:** 2.4 GHz
- **Mobile phones:** 0.8 to 2.1 GHz
- **Dataline protection (PC, Notebook):** 0 to 0.2 GHz

- **BAT60A**
- **BAT54**
- **BAS125**
- **BAT63**
- **BAT68**
- **BAT62**
- **BAT60**
- **BAT17**
- **BAT70**
- **BAT52**
- **BAT40**
- **BAT165**
- **BAT64**
- **BAT60B**
- **BAT63 series**
- **BAT68 series**
- **BAS125 series**
- **BAS40 series**
- **BAS70 series**
- **BAS52 series**
- **BAS60 series**

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Schottky Diode Portfolio
Max. Current vs. Breakdown Voltage

> Schottky Diodes
Medium Power AF-Schottky Family
For DC/DC Converter, Battery Charger, ....

> Schottky Diodes

**Smallest package =>** Ideal for Mobile Phone, PDA, Portable Computer, Digital Still Camera, ...

- **Max. current IF:** 0.2 A to 2.0 A; max. reverse voltage VR: 10 V to 45 V
- **Low VF-type and low IR-types available**
- **High ESD ruggedness**

<table>
<thead>
<tr>
<th>Type</th>
<th>IF appl. [A]</th>
<th>VF @ IF appl. [V]</th>
<th>Vr max [V]</th>
<th>IR @ 10V [µA]</th>
<th>C @ -5V [pF]</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAT165</td>
<td>0.2</td>
<td>0.4</td>
<td>40</td>
<td>0.2</td>
<td>12</td>
<td>SOD323</td>
</tr>
<tr>
<td>BAS52-02V</td>
<td>0.2</td>
<td>0.49</td>
<td>45</td>
<td>0.2</td>
<td>7</td>
<td>SC79</td>
</tr>
<tr>
<td>BAS3005A-02V</td>
<td>0.5</td>
<td>0.45</td>
<td>30</td>
<td>2.5</td>
<td>10</td>
<td>SC79</td>
</tr>
<tr>
<td>BAS3005B-02V</td>
<td>0.5</td>
<td>0.55</td>
<td>30</td>
<td>1.5</td>
<td>6</td>
<td>SC79</td>
</tr>
<tr>
<td>BAS3010A-03W</td>
<td>1.0</td>
<td>0.41</td>
<td>30</td>
<td>10</td>
<td>28</td>
<td>SOD323</td>
</tr>
<tr>
<td>BAS3010B-03W</td>
<td>1.0</td>
<td>0.48</td>
<td>30</td>
<td>1</td>
<td>33</td>
<td>SOD323</td>
</tr>
<tr>
<td>BAT60A</td>
<td>2.0</td>
<td>0.4</td>
<td>10</td>
<td>2000</td>
<td>20</td>
<td>SOD323</td>
</tr>
<tr>
<td>BAT60B</td>
<td>2.0</td>
<td>0.55</td>
<td>10</td>
<td>10</td>
<td>25</td>
<td>SOD323</td>
</tr>
</tbody>
</table>

**Package size:** SC79: 1.6 x 0.8 mm; SOD323: 2.5 x 1.25 mm

**Color code:** Low VF-type; Low IR-type
Why use Schottky diodes for Reverse Polarity Protection (RPP)?

- Schottky diodes have lower forward voltage ($V_F$), typically ~ 0.3 volts, as opposed to ~ 0.7 volts for Silicon diodes.

This can be a significant advantage in some applications, e.g. for LED lighting arrays, where goal is to put as many LED’s into one “stack” as possible. Minimizing diode voltage drop might mean being able to add one more LED to the LED stack.

The lower $V_F$ of Schottky diodes also means reduced power dissipation / higher DC efficiency in the overall circuit.

- **2. Speed.** Schottky diodes generally “switch” faster than Silicon diodes.
Schottky Diodes vs. Silicon Diodes

Performance comparison

Diode forward current vs. forward voltage drop

Calculation of power loss per diode:

- Standard Silicon Diode:
  \[ P_{tot} = 0.7 \text{ A} \times 1.6 \text{ V} = 1.1 \text{ W} \]

- Low VF Silicon Diode:
  \[ P_{tot} = 0.7 \text{ A} \times 1.0 \text{ V} = 0.7 \text{ W} \] (-36%)

- Low VF Schottky Diode:
  \[ P_{tot} = 0.7 \text{ A} \times 0.5 \text{ V} = 0.35 \text{ W} \] (-68%)
Reverse Polarity Protection („RPP“) with BAS30xx families e.g. for LED drivers, battery chargers.

> Schottky Diodes

Plug to DC power supply

Prevents damage to circuit when DC plug is inserted backwarded. **BUT** in this case the circuit will not function.

Protects circuit from reverse polarity damage. **AND** circuit will function properly even if DC power plug is inserted backwards.

Schottky Diode: BAS3010S-03LRH*, BAS3010A-03W

BAS3020B*

Schottky Diode Array: BAS3007A-RPP*

*New Products on request
Schottky Diodes for Mixer Applications

- Schottky Diodes

Low capacitance value for high frequency range
  - Low & medium Schottky Barrier for low LO mixers
  - Available as single and dual diodes
  - Latest type BAT24-02LS with ultra-low capacitance for 24GHz Radar Modules, etc.

for WLAN applications: also available in TSLP-RH

In super-mini TSSLP package

<table>
<thead>
<tr>
<th></th>
<th>BAT15xx</th>
<th>BAT17xx</th>
<th>BAT24-02LS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT@0V</td>
<td>0.26 pF</td>
<td>0.55 pF</td>
<td>0.22 pF</td>
</tr>
<tr>
<td>VF @1mA</td>
<td>230 mV</td>
<td>340 mV</td>
<td>230 mV</td>
</tr>
<tr>
<td>IF max</td>
<td>110 mA</td>
<td>130 mA</td>
<td>110 mA</td>
</tr>
</tbody>
</table>
Ultra Low Parasitic Inductance & Capacitance
Schottky Diode BAT24-02LS

> Schottky Diodes

RF mixer and detector Schottky diodes with integrated guard ring
- AEC Q101 (automotive) qualified
- Wide operating temperature range: -55 ~ 150°C
- Package size: 0.6mm*0.3mm*0.31mm
- Target applications: 24GHz radar modules
  Electrical Toll Collection, etc.
- Competitor types: MACOM MA4E2502L series

<table>
<thead>
<tr>
<th>BAT24-02LS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ls</strong></td>
</tr>
<tr>
<td><strong>CT@0V</strong></td>
</tr>
<tr>
<td><strong>VF @1mA</strong></td>
</tr>
<tr>
<td><strong>IF max</strong></td>
</tr>
<tr>
<td><strong>Frequency range</strong></td>
</tr>
</tbody>
</table>
Schottky Diodes for Signal Detection
(Power Leveling)

> Schottky Diodes

- Low capacitance value for high frequency range
- Low & medium Schottky Barrier for high sensitivity in detector appl.
- Available as single and dual diodes

New: BAT62-02LS
In super-mini TSSLP

New: BAT63-02V
in SC79 package!

<table>
<thead>
<tr>
<th></th>
<th>BAT62xx</th>
<th>BAT63xx</th>
<th>BAT68xx</th>
<th>BAS70xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT@0V</td>
<td>0.35 pF</td>
<td>0.75 pF</td>
<td>0.75 pF</td>
<td>1.5 pF</td>
</tr>
<tr>
<td>VF @1mA</td>
<td>440 mV</td>
<td>318 mV</td>
<td>318 mV</td>
<td>375 mV</td>
</tr>
<tr>
<td>IF max</td>
<td>20 mA</td>
<td>130 mA</td>
<td>130 mA</td>
<td>70 mA</td>
</tr>
</tbody>
</table>
**BAT63-series**  
Zero Bias for Tire Pressure Monitoring Systems (TPMS)

> Schottky Diodes

| Product description |

Zero bias Schottky Diode for RF signal detection, especially optimized for high temperature application

Applications: Tire pressure monitoring system (TPMS), Electronic Toll Collect (ETC), etc

Key advantage: NO degradation of detection sensitivity at higher temperatures

| Forward characteristic comparison for different barrier types |

Detection sensitivity at 25°C

Detection sensitivity at 150°C
BAT62-09S
High Isolation Schottky Diode Pair in SOT363

> Schottky Diodes

Application / Features
- Large signal detector in PA modules
- Improved cross-talk isolation

Competition
- Agilent HSMS series

Status: mass production

Other available configurations:
- Single: in SOT143 / TSLP / TSSLP / SOD323 / SCD80
- Dual: in SOT343 / TSLP4
Schottky Diodes for Clamping / Circuit Protection / High Speed Switching

- Schottky Diodes for clipping & clamping applications
- Schottky Diodes for circuit protection
- Schottky Diodes for high speed switching
- Low capacitance value for high frequency range
- Available as single and dual diodes

<table>
<thead>
<tr>
<th></th>
<th>BAS125xx</th>
<th>BAS40xx</th>
<th>BAT54xx</th>
<th>BAT64xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT@0V</td>
<td>1.0 pF</td>
<td>3.0 pF</td>
<td>7.0 pF</td>
<td>6.0 pF</td>
</tr>
<tr>
<td>VF @1mA</td>
<td>385 mV</td>
<td>310 mV</td>
<td>240 mV</td>
<td>320 mV</td>
</tr>
<tr>
<td>IF max</td>
<td>100 mA</td>
<td>120 mA</td>
<td>200 mA</td>
<td>250 mA</td>
</tr>
</tbody>
</table>
Problem: Noisy data-spikes can damage digital circuits!

Two Schottky diodes are used for protecting sensitive circuit elements against spikes.

Protection Diode: BAT17xx, BAT62xx, BAT54xx, BAT64xx, BAT68xx, BAS40xx, BAS70xx, BAS125xx

Available Packages: SC79, SCD80, SOD323, SOT23, SOT323, SOT143, SOT343, TSLP-2
Latest AF-Schottky Diodes with Wide Package Portfolio
BAT54-series, BAT64-series

> Schottky Diodes

- For clipping & clamping applications
- For circuit protection
- For high speed switching
- Available as single and dual diodes

<table>
<thead>
<tr>
<th></th>
<th>BAT64xx</th>
<th>BAT54xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_{T}@0V$</td>
<td>4.0 pF</td>
<td>7.0 pF</td>
</tr>
<tr>
<td>$U_F@1mA$</td>
<td>320 mV</td>
<td>240 mV</td>
</tr>
<tr>
<td>$I_{F_{max}}$</td>
<td>250 mA</td>
<td>200 mA</td>
</tr>
</tbody>
</table>

- **SOT23**
  - BAT54* (single)
  - BAT54-04* (series)
  - BAT54-05* (com. cathode)
  - BAT54-06* (com. anode)

- **SOT323**
  - BAT54W* (single)
  - BAT54-04W* (series)
  - BAT54-05W* (com. cathode)
  - BAT54-06W* (com. anode)

- **SC79**
  - BAT54-02V (single)
  - BAT54-02LRH (single)

- **SCD80**
  - BAT64-02W (single)

* Configurations available also for BAT64 family
Schottky Diodes for Modems & Battery Powered Applications

> Schottky Diodes

**Modem Protection**

**BAT240A**
- High $V_R$ breakdown
- $C_T$ 11.5 pF
- $V_R$ 240 V
- $I_{f_{max}}$ 400 mA

**High breakdown voltage**

**Battery Powered Applications**

**BAT60A**
- Very low voltage drop $V_F$
- $C_T$ 20.0 pF
- $V_F@10mA$ 0.12 mV
- $I_{f_{max}}$ 3.0 A

**Low voltage drop**

**BAT60B**
- Low voltage drop $V_F$
- $C_T$ 25.0 pF
- $V_F@10mA$ 0.24 mV
- $I_{f_{max}}$ 3.0 A
BAT240A for Modems Applications

- Schottky Diodes

Worldwide programmable SW Modem (PCI 2.1 interface)

- PITA PSB 4600
- AUS-D PSB 4596
- AUS-A PSB 4595

Modem with optical DAA

- DM207
- IL338
- DAA 2000 Kit
- DL207

Optional

Tip

Ring

PCI Interface

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Available Schottky Diodes in TS(S)Lp

> Schottky Diodes

BAS40-02L
BAS70-02L
BAT54-02LRH

TSLP2
TSLP2
TSLP2-RH

High speed switching clipping and clamping

BAT15-02LRH
BAT15-07LRH(D)
BAT15-098LRH(D)
BAT15-099LRH(D)
BAT24-02LS
BAT62-02LS
BAT62-02L
BAT62-07L4(D)

TSLP2-RH
TSLP4-RH
TSLP4-RH
TSLP4-RH
TSSLP2
TSSLP2
TSLP2
TSLP4-RH

RF mixer and detector, power leveling

1.2 x 0.8 x 0.4 mm
## Schottky Diode Lineup

### RF Mixer / Detection / Power Leveling

> Schottky Diodes

<table>
<thead>
<tr>
<th>Type</th>
<th>$V_{R\text{max}}$ [V]</th>
<th>$I_{F\text{max}}$ [mA]</th>
<th>$C_T$ [pF]</th>
<th>$V_F$ [mV]</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAT15-02LRH</td>
<td>4</td>
<td>110</td>
<td>0.26</td>
<td>230</td>
<td>TSLP2</td>
</tr>
<tr>
<td>BAT15-03W</td>
<td>4</td>
<td>110</td>
<td>0.26</td>
<td>230</td>
<td>SOD323</td>
</tr>
<tr>
<td>BAT15-04W</td>
<td>D</td>
<td>4</td>
<td>110</td>
<td>0.26</td>
<td>SOT323</td>
</tr>
<tr>
<td>BAT15-05W</td>
<td>D</td>
<td>4</td>
<td>110</td>
<td>0.26</td>
<td>SOT323</td>
</tr>
<tr>
<td>BAT15-07LRH</td>
<td>D</td>
<td>4</td>
<td>110</td>
<td>0.26</td>
<td>TSLP4</td>
</tr>
<tr>
<td>BAT15-098LRH</td>
<td>D</td>
<td>4</td>
<td>110</td>
<td>0.26</td>
<td>TSLP4</td>
</tr>
<tr>
<td>BAT15-099 / LRH</td>
<td>D</td>
<td>4</td>
<td>110</td>
<td>0.26</td>
<td>SOT143</td>
</tr>
<tr>
<td>BAT15-099R</td>
<td>Q</td>
<td>4</td>
<td>110</td>
<td>0.38</td>
<td>SOT143</td>
</tr>
<tr>
<td>BAT17</td>
<td>4</td>
<td>130</td>
<td>0.55</td>
<td>340</td>
<td>SOT23</td>
</tr>
<tr>
<td>BAT17-04 / W</td>
<td>D</td>
<td>4</td>
<td>130</td>
<td>0.55</td>
<td>SOT23 / SOT323</td>
</tr>
<tr>
<td>BAT17-05 / W</td>
<td>D</td>
<td>4</td>
<td>130</td>
<td>0.55</td>
<td>SOT23 / SOT323</td>
</tr>
<tr>
<td>BAT17-06W</td>
<td>D</td>
<td>4</td>
<td>130</td>
<td>0.55</td>
<td>SOT323</td>
</tr>
<tr>
<td>BAT17-07</td>
<td>D</td>
<td>4</td>
<td>130</td>
<td>0.75</td>
<td>SOT143</td>
</tr>
<tr>
<td>BAT24-02LS</td>
<td>4</td>
<td>110</td>
<td>0.21</td>
<td>230</td>
<td>TSSLP2</td>
</tr>
<tr>
<td>BAT62</td>
<td>40</td>
<td>20</td>
<td>0.35</td>
<td>580</td>
<td>SOT143</td>
</tr>
<tr>
<td>BAT62-02L / -02LS /-02W</td>
<td>40</td>
<td>120</td>
<td>0.35</td>
<td>580</td>
<td>TSLP2 / TSSLP2 /SCD80</td>
</tr>
<tr>
<td>BAT62-03W</td>
<td>40</td>
<td>20</td>
<td>0.35</td>
<td>580</td>
<td>SOD323</td>
</tr>
<tr>
<td>BAT62-07L4 / W</td>
<td>D</td>
<td>40</td>
<td>20</td>
<td>0.35</td>
<td>TSLP4 / SOT343</td>
</tr>
<tr>
<td>BAT62-09S</td>
<td>D</td>
<td>40</td>
<td>20</td>
<td>0.35</td>
<td>SOT363</td>
</tr>
<tr>
<td>BAT63-02V</td>
<td>3</td>
<td>100</td>
<td>0.65</td>
<td>190</td>
<td>SC79</td>
</tr>
<tr>
<td>BAT63-07W</td>
<td>D</td>
<td>3</td>
<td>100</td>
<td>0.65</td>
<td>SOT343</td>
</tr>
<tr>
<td>BAT68</td>
<td>8</td>
<td>130</td>
<td>0.75</td>
<td>318</td>
<td>SOT23</td>
</tr>
<tr>
<td>BAT68-04 / W</td>
<td>D</td>
<td>8</td>
<td>130</td>
<td>0.75</td>
<td>SOT23 / SOT323</td>
</tr>
<tr>
<td>BAT68-06 / W</td>
<td>D</td>
<td>8</td>
<td>130</td>
<td>0.75</td>
<td>SOT23 / SOT323</td>
</tr>
<tr>
<td>BAT68-07W</td>
<td>D</td>
<td>8</td>
<td>130</td>
<td>0.75</td>
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<tr>
<td>BAT68-08S</td>
<td>T</td>
<td>8</td>
<td>130</td>
<td>0.75</td>
<td>SOT363</td>
</tr>
</tbody>
</table>
## Schottky Diode Lineup

### High speed switching / clipping / clamping

> Schottky Diodes

<table>
<thead>
<tr>
<th>Type</th>
<th>( V_{R_{\text{max}}} ) [V]</th>
<th>( I_{F_{\text{max}}} ) [mA]</th>
<th>( C_{T} ) [pF]</th>
<th>( V_F ) [mV]</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAS125-04W</td>
<td>25</td>
<td>100</td>
<td>0,95</td>
<td>385</td>
<td>SOT323</td>
</tr>
<tr>
<td>BAS125-05W</td>
<td>25</td>
<td>100</td>
<td>0,95</td>
<td>385</td>
<td>SOT323</td>
</tr>
<tr>
<td>BAS125-06W</td>
<td>25</td>
<td>100</td>
<td>0,95</td>
<td>385</td>
<td>SOT323</td>
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<tr>
<td>BAS125-07W</td>
<td>25</td>
<td>100</td>
<td>0,95</td>
<td>385</td>
<td>SOT343</td>
</tr>
<tr>
<td>BAS140W</td>
<td>40</td>
<td>120</td>
<td>3</td>
<td>310</td>
<td>SOT323</td>
</tr>
<tr>
<td>BAS170W</td>
<td>70</td>
<td>70</td>
<td>1,5</td>
<td>375</td>
<td>SOT323</td>
</tr>
<tr>
<td>BAS40 / -02L</td>
<td>40</td>
<td>120</td>
<td>3</td>
<td>310</td>
<td>SOT323 / TSLP2</td>
</tr>
<tr>
<td>BAS40-04</td>
<td>D 40</td>
<td>120</td>
<td>3</td>
<td>310</td>
<td>SOT323</td>
</tr>
<tr>
<td>BAS40-05 / W</td>
<td>D 40</td>
<td>120</td>
<td>3</td>
<td>310</td>
<td>SOT323</td>
</tr>
<tr>
<td>BAS40-06 / W</td>
<td>D 40</td>
<td>120</td>
<td>3</td>
<td>310</td>
<td>SOT323</td>
</tr>
<tr>
<td>BAS40-07 / W</td>
<td>D 40</td>
<td>120</td>
<td>3</td>
<td>310</td>
<td>SOT143 / SOT343</td>
</tr>
<tr>
<td>BAS70</td>
<td>70</td>
<td>70</td>
<td>1,6</td>
<td>375</td>
<td>SOT323</td>
</tr>
<tr>
<td>BAS70-02L / -02W</td>
<td>70</td>
<td>70</td>
<td>1,5</td>
<td>375</td>
<td>TSLP2 / SCD80</td>
</tr>
<tr>
<td>BAS70-04 / W</td>
<td>D 70</td>
<td>70</td>
<td>1,6 / 1,5</td>
<td>375</td>
<td>SOT323 / SOT323</td>
</tr>
<tr>
<td>BAS70-04S</td>
<td>Q 70</td>
<td>70</td>
<td>1,6</td>
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<tr>
<td>BAS70-05 / W</td>
<td>D 70</td>
<td>70</td>
<td>1,6 / 1,5</td>
<td>375</td>
<td>SOT323 / SOT323</td>
</tr>
<tr>
<td>BAS70-06 / W</td>
<td>D 70</td>
<td>70</td>
<td>1,6 / 1,5</td>
<td>375</td>
<td>SOT323 / SOT323</td>
</tr>
<tr>
<td>BAS70-07 / W</td>
<td>D 70</td>
<td>70</td>
<td>1,5</td>
<td>375</td>
<td>SOT143 / SOT343</td>
</tr>
<tr>
<td>BAT240A</td>
<td>D 240</td>
<td>400</td>
<td>11,5</td>
<td>325</td>
<td>SOT323</td>
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<tr>
<td>BAT54 / W</td>
<td>30</td>
<td>200</td>
<td>&lt; 10</td>
<td>&lt;320</td>
<td>SOT23 / SOT323</td>
</tr>
<tr>
<td>BAT54-02LRH / -02V</td>
<td>30</td>
<td>200</td>
<td>&lt;10</td>
<td>&lt;320</td>
<td>TSLP2 / SC79</td>
</tr>
<tr>
<td>BAT54-04 / W</td>
<td>D 30</td>
<td>200</td>
<td>&lt;10</td>
<td>&lt;320</td>
<td>SOT23 / SOT323</td>
</tr>
<tr>
<td>BAT54-05 / W</td>
<td>D 30</td>
<td>200</td>
<td>&lt;10</td>
<td>&lt;320</td>
<td>SOT23 / SOT323</td>
</tr>
<tr>
<td>BAT54-06 / W</td>
<td>D 30</td>
<td>200</td>
<td>&lt;10</td>
<td>&lt;320</td>
<td>SOT23 / SOT323</td>
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<tr>
<td>BAT64 / -02V / -02W</td>
<td>40</td>
<td>250</td>
<td>4</td>
<td>320</td>
<td>SOT23 / SC79 / SCD80</td>
</tr>
<tr>
<td>BAT64-04 / W</td>
<td>D 40</td>
<td>250</td>
<td>4</td>
<td>320</td>
<td>SOT23 / SOT323</td>
</tr>
<tr>
<td>BAT64-05 / W</td>
<td>D 40</td>
<td>250</td>
<td>4</td>
<td>320</td>
<td>SOT23 / SOT323</td>
</tr>
<tr>
<td>BAT64-06 / W</td>
<td>D 40</td>
<td>250</td>
<td>4</td>
<td>320</td>
<td>SOT23 / SOT323</td>
</tr>
</tbody>
</table>
## Schottky Diode Lineup

### Medium power IF_{max} > 500 mA

> Schottky Diodes

<table>
<thead>
<tr>
<th>Type</th>
<th>V_{Rmax} [V]</th>
<th>I_{Fmax} [mA]</th>
<th>I_{app.} [mA]</th>
<th>V_{F@I_{app.}} [mV]</th>
<th>I_{R} [µA]</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAS3005A-02V</td>
<td>30</td>
<td>500</td>
<td>500</td>
<td>450</td>
<td>&lt;300</td>
<td>SC79</td>
</tr>
<tr>
<td>BAS3005B-02V</td>
<td>30</td>
<td>500</td>
<td>500</td>
<td>550</td>
<td>&lt;25</td>
<td>SC79</td>
</tr>
<tr>
<td>BAS3010A-03W</td>
<td>30</td>
<td>1000</td>
<td>1000</td>
<td>410</td>
<td>&lt;200</td>
<td>SOD323</td>
</tr>
<tr>
<td>BAS3010B-03W</td>
<td>30</td>
<td>1000</td>
<td>1000</td>
<td>480</td>
<td>&lt;20</td>
<td>SOD323</td>
</tr>
<tr>
<td>BAS52-02V</td>
<td>45</td>
<td>750</td>
<td>200</td>
<td>490</td>
<td>&lt;10</td>
<td>SC79</td>
</tr>
<tr>
<td>BAT165</td>
<td>40</td>
<td>750</td>
<td>250</td>
<td>440</td>
<td>&lt;50</td>
<td>SOD323</td>
</tr>
<tr>
<td>BAT60A</td>
<td>10</td>
<td>3000</td>
<td>2000</td>
<td>400</td>
<td>300</td>
<td>SOD323</td>
</tr>
<tr>
<td>BAT60B</td>
<td>10</td>
<td>3000</td>
<td>2000</td>
<td>450</td>
<td>5</td>
<td>SOD323</td>
</tr>
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</table>
Table of Contents

- Applications
- RF Discretes
- Schottky Diodes
- HiPAC, TVS Diodes, Silicon Microphone
- LED Drivers
- AF Discretes
- General Information
HiPAC, TVS Diodes, Silicon Microphone

- HiPAC, TVS Diodes, Silicon Microphone

- TVS Diodes are very flexible and robust ESD protection devices
- HiPAC offers both ESD/EMI and high integration for advanced applications

### TVS Diodes

- ESD protection
- High power capability
- Design flexibility
- ESD-bug fixing
- Easy and fast system design-in
- Single- or Multi-channel in one package
- 24 Volt capability

### HiPAC

- Monolithic integrated ESD/EMI protection
- Integration of high performance passives
- Superior performance compared to ICs
- Multi-channel in one package
- Customized-design possibility
- HiPAC exceeds ESD/EMI protection applications, e.g. RF filters, in stage matching
HiPAC: Smart Solution with a Maximum of Space Saving

THE SMART SOLUTION: Integrated Discretes
- Reduced Costs
- Enhanced Reliability
- Better Performance

THE CLUMSY SOLUTION: Discrete Components

THE TASK with DISCRETES
Providing new possibilities and adding value to your business

- Improvement of functional performance
- Reduction of board space
- Reduced No. of devices / suppliers
- Lower assembly, pick-and-place and inventory costs
- Improved overall quality and reliability level results in higher production yields
- Provides ESD / EMI protection at reasonable costs to reduce warranty costs
- Exceeding IEC61000-4-2 requirements: 15 kV contact discharge for all outside I/O
- Driver towards miniaturization and adding new functionality
BGF100 / BGF200
Audio Filter for Differential / Single Ended Microphones

- Improves audio performance
- Eliminates system distortions of headset “antenna”
- 15 kV ESD-protection
- Low pass filter circuit with ESD diodes, R’s and C’s
- WLP11 Package (BGF100)
- WLP8 (BGF200)

e.g. BGF100

---

![BGF100](image_url)

**Attenuation**

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>channel1</th>
<th>channel2</th>
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<tbody>
<tr>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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BGF104 Flash Memory ESD Protection
High Speed Multi Media Card (HSMMC)

> HiPAC, TVS Diodes, Silicon Microphone > HiPAC

- **ESD protection according IEC61000-4-2**
  - 15 kV ESD protection for all pins to the outside
  - 2 kV ESD protection for all internal pins
- **Integrated filter function for EMI reduction**
- **Capacity per Line C_T: 16 pF**
- **Package: WLP-16**
- **Solder Ball Pitch: 500 µm**
BGF108 & BGF109  
7 Channel & 10 Channel LCD Protection

> HiPAC, TVS Diodes, Silicon Microphone > HiPAC

- **7x / 10x on chip**

- ESD protection acc. IEC61000-4-2
  - 15 kV ESD protection at LCD interface of mobile phone
- Integrated filter function for EMI reduction
- Capacity per Line CT: 14 pF
- Package: WLP-18 (BGF108), WLP-24 (BGF109)
- Solder Ball Pitch: 400 µm
BGF105 & BGF106
SIM Card Interface Protection

> HiPAC, TVS Diodes, Silicon Microphone > HiPAC

- ESD protection acc. IEC61000-4-2
  - 2 kV @ Pin A3, B3, C3
  - 15 kV @ A2, B1, C1, C2
- Integrated filter function for EMI reduction
- Capacity per Line $C_{T\text{max}}$: 20 pF
- Package: WLP-8
- Solder Ball Pitch: 500 µm (BGF105) / 400 µm (BGF106)
- SOP – Q3CY2007
BGF110
SD Card ESD Protection

> HiPAC, TVS Diodes, Silicon Microphone > HiPAC

- ESD protection acc. IEC61000-4-2
  - 15 kV for SD Card Interface
  - 2 kV ESD protection at internal I/O
- Integrated filter function for EMI reduction
- Capacity per Line CT: 16 pF
- Package: WLP-24
- Solder Ball Pitch: 400 µm
- SOP – Q3CY2007
BGF111
TV out filter & ESD protection

> HiPAC, TVS Diodes, Silicon Microphone > HiPAC

- ESD protection acc. IEC61000-4-2
  - 15 kV for Ext. I/O
  - 2 kV ESD for Int. I/O
- Integrated filter function for EMI reduction
- Capacity per Line CT: 44 pF
- 75 Ohm interface (video interface)
- Package: WLP-4
- Solder Ball Pitch: 400 µm
- SOP – Q3CY2007
Use the benefits of our HiPAC technologies, the function blocks can be realized:
- Matching Networks for e.g. TRX to PA, SAW/BAW to TRX, LNA...
- Filters (BP, LP, HP, Harmonic Filters)
- Balun/Auto-trafo for mode conversion
- Power detection through coupler
- Hybrid coupler
BGH92M/BGH182M
HiPAC for Wireless Applications: H3 – Filter

> HiPAC, TVS Diodes, Silicon Microphone > HiPAC

Features
- Passband insertion loss typ. 2.8 dB
- H3 suppression typ. 45 dB
- H4 common mode suppression typ. 40 dB
- Low amplitude ripple
- Balanced to single ended operation
  - Input 390 Ohm balanced
  - Output 50 Ohm single ended
- Integrated DC-biasing to in- and output
- TSLP 7
Table of Contents

- HiPAC, TVS Diodes, Silicon Microphone
  - HiPAC
  - TVS Diodes
  - Silicon Microphone
1 or 2-Channel Low Capacitance bi-directional ESD Diode in Ultra-Small TSLP Package

> HiPAC, TVS Diodes, Silicon Microphone > TVS Diodes

ESD8V0L1B-02LRH & ESD8V0L2B-03L

**Target Application**

ESD protection of high-speed data interfaces like USB 2.0, 10/100 Ethernet, Firewire, Video, Serial/Parallel and LAN/WAN ports; For applications from 3.3V up to 14V

**Parameter Overview**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{RWM} )</td>
<td>14V (V+)</td>
<td>8V (V-)</td>
</tr>
<tr>
<td>( I_{RWM} )</td>
<td>3V, 25°C</td>
<td>100nA max</td>
</tr>
<tr>
<td>( C_L )</td>
<td>0V, 1MHz</td>
<td>2pF/4pF/8.5pF typ.</td>
</tr>
<tr>
<td>IEC61000-4-2 (contact)</td>
<td>&gt;15kV</td>
<td></td>
</tr>
<tr>
<td>IEC61000-4-4 (5/50ns)</td>
<td>&gt;40A</td>
<td></td>
</tr>
<tr>
<td>IEC61000-4-5 (8/20( \mu )s)</td>
<td>&gt;1A / &gt;2A</td>
<td></td>
</tr>
</tbody>
</table>

ESD protection of high-speed data interfaces like USB 2.0, 10/100 Ethernet, Firewire, Video, Serial/Parallel and LAN/WAN ports; For applications from 3.3V up to 14V

**Schematic and PIN Configuration**

**Application Example**

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Ultra Low Capacitance, Low Intermodulation, RF ESD Protection Diodes

> HiPAC, TVS Diodes, Silicon Microphone > TVS Diodes

ESDxPyRF-series

Applications in anti-parallel configuration
For low RF signal levels without superimposed DC voltage: e.g. GPS, XM-Radio, Sirius, DVB, DMB, DAB, Remote keyless entry

Applications in rail-to-rail configuration
For high RF signal levels or low RF signal levels with superimposed DC voltage: e.g. HDMI, S-ATA, Gbit Ethernet

Parameter Overview

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CL}$</td>
<td>3A, 8/20µs</td>
<td>~4V</td>
</tr>
<tr>
<td>$C_{L(ESD0P8RF)}$</td>
<td>0V, 1MHz</td>
<td>0.8pF</td>
</tr>
<tr>
<td>$C_{L(ESD1P0RF)}$</td>
<td>0V, 1MHz</td>
<td>1.0 pF</td>
</tr>
<tr>
<td>IEC61000-4-2</td>
<td>(contact)</td>
<td>&gt;15kV</td>
</tr>
<tr>
<td>IEC61000-4-4</td>
<td>(5/50ns)</td>
<td>&gt;40A</td>
</tr>
<tr>
<td>IEC61000-4-5</td>
<td>(8/20µs)</td>
<td>&gt;10A</td>
</tr>
</tbody>
</table>

Application Example

RF Circuit

ESDxPyRF-series

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1- to 5-Channel TVS Diode Arrays for General Purpose Protection

> HiPAC, TVS Diodes, Silicon Microphone > TVS Diodes

**ESD5V0S1U-03W / ESD5V0S2U / ESD5V0S4US / ESD5V0S5US**

### Target Application

ESD, EFT & lightning protection; Low speed data interface (Power Line, Microphone, Speaker, Headset, Flash Card) in **5V applications** (Cellular phone, PDA, Digital Still Camera, MP3-player, etc.)

### Parameter Overview

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{RWM} )</td>
<td>5A, 8/20( \mu )s</td>
<td>8.8V max</td>
</tr>
<tr>
<td>( V_{CL} )</td>
<td>5V, 25°C</td>
<td>2( \mu )A typ.</td>
</tr>
<tr>
<td>( I_{RWM} )</td>
<td>8/20( \mu )s</td>
<td>up to 330W</td>
</tr>
<tr>
<td>( C_L )</td>
<td>0V, 1MHz</td>
<td>&lt;500pF</td>
</tr>
<tr>
<td>IEC61000-4-2 (contact)</td>
<td></td>
<td>≥25kV</td>
</tr>
<tr>
<td>IEC61000-4-4 (5/50ns)</td>
<td></td>
<td>up to 40A</td>
</tr>
<tr>
<td>IEC61000-4-5 (8/20( \mu )s)</td>
<td></td>
<td>up to 30A</td>
</tr>
</tbody>
</table>

### Application Example

**ESD5V0S1U-03W** (SOD323)  **ESD5V0S2U** (SOT23)  **ESD5V0S4US** (SOT363)  **ESD5V0S5US** (SOT363)

**ESD5V0S1U-03W** / **ESD5V0S2U** / **ESD5V0S4US** / **ESD5V0S5US**
2-Channel Bi-Directional TVS Diode Array For CAN Bus Protection

> HiPAC, TVS Diodes, Silicon Microphone > TVS Diodes

**ESD24VS2B & ESD24VS2U**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{RWM}$</td>
<td>24V</td>
<td></td>
</tr>
<tr>
<td>$V_{CL}$</td>
<td>5A, 8/20µs</td>
<td>40V</td>
</tr>
<tr>
<td>$I_{RWM}$</td>
<td>24V, 25°C</td>
<td>10nA max</td>
</tr>
<tr>
<td>$P_{PK}$</td>
<td>8/20µs</td>
<td>180W per diode</td>
</tr>
<tr>
<td>$C_L$</td>
<td>0V, 1MHz</td>
<td>24pF typ.</td>
</tr>
<tr>
<td>IEC61000-4-2</td>
<td>(contact)</td>
<td>30kV contact!</td>
</tr>
<tr>
<td>IEC61000-4-4</td>
<td>(5/50ns)</td>
<td>40A</td>
</tr>
<tr>
<td>IEC61000-4-5</td>
<td>(8/20µs)</td>
<td>5A per diode</td>
</tr>
</tbody>
</table>

ESD, EFT & lightning protection; Low and High Speed **CAN Automotive** networks and or **Industrial Control Networks**

IC protection in **24V applications** (Notebooks, desktops, and servers)

**CAN Bus TVS**

**Schematic and PIN Configuration**

**Application Example**

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ESD, EFT & lightning protection of ADSL, ISDN, WAN, LAN or other telecom application (rail-to-rail).

**ESD70VU2RR-07**

### Target Application

ESD, EFT & lightning protection of ADSL, ISDN, WAN, LAN or other telecom application (rail-to-rail).

### Parameter Overview (preliminary)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{\text{RWM}}$</td>
<td>70V max</td>
<td></td>
</tr>
<tr>
<td>$V_{\text{CL}}$</td>
<td>10A, 8/20µs 4V max</td>
<td></td>
</tr>
<tr>
<td>$I_{\text{RWM}}$</td>
<td>70V, 25°C 5µA max.</td>
<td></td>
</tr>
<tr>
<td>$P_{\text{PK}}$</td>
<td>8/20µs up to 330W</td>
<td></td>
</tr>
<tr>
<td>$C_{\text{L}}$</td>
<td>0V, 1MHz &lt;5pF</td>
<td></td>
</tr>
<tr>
<td>IEC61000-4-2</td>
<td>(contact) ≥25kV</td>
<td></td>
</tr>
<tr>
<td>IEC61000-4-4</td>
<td>(5/50ns) &gt;40A</td>
<td></td>
</tr>
<tr>
<td>IEC61000-4-5</td>
<td>(8/20µs) &gt;24A</td>
<td></td>
</tr>
</tbody>
</table>

### Schematic and PIN Configuration

![Schematic and PIN Configuration](image)

**ESD70VU2RR-07 (SOT143)**

### Application Example

![Application Example](image)

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TVS Diodes Combine a Very Fast Response Speed with Lowest Clamping Voltages

<table>
<thead>
<tr>
<th></th>
<th>TVS Diode</th>
<th>Zener Diode</th>
<th>MOV/MLV</th>
<th>Polymer ESD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Response Speed</strong></td>
<td>Very Fast</td>
<td>Very Fast</td>
<td>Fast (~few ns)</td>
<td>Very fast</td>
</tr>
<tr>
<td>(Voltage Limit Speed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Surge Handling Capability</strong></td>
<td>Medium to High</td>
<td>Low to Medium (not specified)</td>
<td>Medium to High</td>
<td>Poor, degradation effects</td>
</tr>
<tr>
<td><strong>Multi-strikes</strong></td>
<td>Very good</td>
<td>Good</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>Line Capacitance</strong></td>
<td>Low to Medium (&gt;0.8pF)</td>
<td>Medium (&gt;30pF)</td>
<td>Low to High</td>
<td>Very Low (0.05 … 3pF)</td>
</tr>
<tr>
<td><strong>Clamping Voltage</strong></td>
<td>Low</td>
<td>Medium</td>
<td>Very High</td>
<td>Very High &gt;300V (Trigger!)</td>
</tr>
<tr>
<td><strong>Precision of Clamping Voltage</strong></td>
<td>Good</td>
<td>Poor</td>
<td>Poor</td>
<td>Good (but high trigger V)</td>
</tr>
<tr>
<td><strong>Wide Range of Breakdown Voltage</strong></td>
<td>Very good</td>
<td>Good</td>
<td>Only &gt;15V</td>
<td>See trigger voltage</td>
</tr>
<tr>
<td><strong>Uni-directional</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Bi-directional</strong></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Leakage Current</strong></td>
<td>Low</td>
<td>Middle</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Comment</strong></td>
<td></td>
<td></td>
<td></td>
<td>Critical SMT</td>
</tr>
<tr>
<td>HiPAC, TVS Diodes, Silicon Microphone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HiPAC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TVS Diodes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silicon Microphone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Application example: Hands Free

> HiPAC, TVS Diodes, Silicon Microphone > Silicon Microphone

- Hands-Free in the car: Low body noise coupling (vibration of the car)
- Directionality with arrays of microphones
- Integration in noise reduction and echo cancellation systems

Microphone Demonstrator Application Example
SMM310
Analog Microphone for Mobile Applications

> HiPAC, TVS Diodes, Silicon Microphone > Silicon Microphone

Description
- Silicon MEMS Microphone
- Surface mount assembly
- Green package (260°C)
- Integrated EMI filtering
- 2kV ESD protection (HBM)
- Small size: 4.72x3.76x1.25mm³
- Part number: MM 310 E6433
- Sales code: SP000267598

Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Typical Value</th>
<th>Unit</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>-42</td>
<td>dBV/Pa</td>
<td>1 kHz, 94 dB SPL</td>
</tr>
<tr>
<td>Input-Referred Noise</td>
<td>28.5</td>
<td>dB</td>
<td>1 Pa, psophometrically weighted</td>
</tr>
<tr>
<td>Signal to Noise</td>
<td>59</td>
<td>dB(A)</td>
<td>1 Pa, A-weighted</td>
</tr>
<tr>
<td>Maximum Sound Pressure Level</td>
<td>110</td>
<td>dB</td>
<td>Total Harmonic Distortion &lt;3%</td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>1.5 – 3.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Current Consumption</td>
<td>70</td>
<td>µA</td>
<td></td>
</tr>
<tr>
<td>Output Impedance</td>
<td>&lt; 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Drive Capability</td>
<td>&lt;100 &gt;10</td>
<td>pF k</td>
<td>output (Pin 1)</td>
</tr>
<tr>
<td>PSRR</td>
<td>65</td>
<td>dB</td>
<td></td>
</tr>
</tbody>
</table>

Frequency response

Focus application
- Mobile phones

Further applications
- Consumer
- Notebooks
- Cameras
- Industrial
- Automotive
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- Applications
- RF Discretes
- Schottky Diodes
- HiPAC, TVS Diodes, Silicon Microphone
- LED Drivers
- AF Discretes
- General Information
Problematic issues faced at operating LEDs

> LED Drivers

1. **Inhomogenous light emission in LED branches in comparison to each other**
   - due to statistical variations of LED properties like forward voltage of up to $\pm$ 20% the current variation in LED branches can be very high

2. **Variation of brightness of all LED branches**
   - due to fluctuations of the voltage supply

3. **Degradation of light emission of LEDs**
   - due to thermal overload or even thermal runaway connected with the decline of the forward voltage of LEDs vs temperature

4. **Increased cost of customers for LEDs**
   - due to required binning for same forward voltage $V_F$ besides brightness and colour temperature index (CRI)
Countermeasures against problems in operating LEDs

1st option: pure resistor biasing

> LED Drivers

**Typical setup without LED driver**

- Inhomogenous light emission can be solved,
- but at the cost of high voltage drop
- Brightness variations due to fluctuations of $V_s$ remains
- Danger of degradation due to thermal overload of LEDs remains

**Conclusion:**
- High voltage drop can result in less number of LEDs in respective branches
- Thermal overload can lead to degradation of LEDs neutralizing the selling argument of long life expectancy of LEDs
- Cheapest countermeasure, but doesn’t solve most critical problems of operating LEDs
Countermeasures against problems in operating LEDs

2nd option: voltage regulator in addition to resistor biasing

> LED Drivers

- inhomogenous light emission can be solved, but
- at the cost of high voltage drop
- brightness variations due to fluctuations of $V_s$, but
- at the cost of 0.15 USD and
- danger of degradation due to thermal overload of LEDs remains

Conclusion:

- high voltage drop can result in less number of LEDs in respective branches
- thermal overload can lead to degradation of LEDs neutralizing the selling argument of long life expectancy of LEDs
- despite significant cost adder, still most critical problems of operating LEDs remain unsolved
Countermeasures against problems in operating LEDs
3rd option: linear mode LED driver from Infineon

> LED Drivers

\[ V_s = 5\ldots18 \text{ V} \]

- inhomogenous light emission can be solved with controller in each branch
- low voltage drop
- brightness variations due to fluctuations of \( V_s \) solved by controller
- danger of degradation due to thermal overload of LEDs solved due to negative temperature coefficient of LED driver
- no voltage regulator required

**Conclusion:**

\( \rightarrow \) Most critical problems of operating LEDs solved at reasonable cost
Linear mode LED-drivers from Infineon
BCR 4xx in SOT143R, SOT343 and SC74

> LED Drivers

**Benefits**
- Low cost and by far superior solution to resistor based solutions
- Output current adjustable by usage of external resistor from 10mA to 60mA
- Suitable for Pulse Width Modulation (PWM), possibility of LED dimming
- Negative temperature coefficient serves as protection for LEDs at higher temperatures

**Application Note**
- AN066

![LED Driver Block Diagram]

LED Driver BCR4XX

Supply Voltage

Control circuit

Sense

Control

R<sub>int</sub>

R<sub>EXT</sub>

(>ON / OFF)

LEDs
## Overview of general purpose linear mode LED drivers

### LED Drivers

<table>
<thead>
<tr>
<th>Application</th>
<th>Package</th>
<th>Vcc, max</th>
<th>Id,typ</th>
<th>Id,max</th>
<th>Vdrop</th>
<th>Ptot</th>
<th>RthJS</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCR401R low current LED Driver</td>
<td>SOT143R</td>
<td>18V</td>
<td>10mA</td>
<td>60mA</td>
<td>1.2V</td>
<td>330mW</td>
<td>190K/W</td>
<td>mass production</td>
</tr>
<tr>
<td>BCR402R universal LED Driver</td>
<td>SOT143R</td>
<td>18V</td>
<td>20mA</td>
<td>60mA</td>
<td>1.4V</td>
<td>330mW</td>
<td>190K/W</td>
<td>mass production</td>
</tr>
<tr>
<td>BCR401W low current LED Driver</td>
<td>SOT343</td>
<td>18V</td>
<td>10mA</td>
<td>60mA</td>
<td>1.2V</td>
<td>500mW</td>
<td>110K/W</td>
<td>samples available</td>
</tr>
<tr>
<td>BCR402W universal LED Driver</td>
<td>SOT343</td>
<td>18V</td>
<td>20mA</td>
<td>60mA</td>
<td>1.4V</td>
<td>500mW</td>
<td>110K/W</td>
<td>samples available</td>
</tr>
<tr>
<td>BCR401U med. current LED Driver</td>
<td>SC74</td>
<td>40V</td>
<td>10mA</td>
<td>65mA</td>
<td>1.4V</td>
<td>500mW</td>
<td>65K/W</td>
<td>samples available in April</td>
</tr>
<tr>
<td>BCR402U med. current LED Driver</td>
<td>SC74</td>
<td>40V</td>
<td>20mA</td>
<td>65mA</td>
<td>1.4V</td>
<td>500mW</td>
<td>65K/W</td>
<td>mass production</td>
</tr>
<tr>
<td>BCR405U high current LED Driver</td>
<td>SC74</td>
<td>40V</td>
<td>50mA</td>
<td>65mA</td>
<td>1.5V</td>
<td>500mW</td>
<td>65K/W</td>
<td>mass production</td>
</tr>
</tbody>
</table>

→ 3 new products added into the portfolio closing the gap
Features
- High LED currents of up to 700mA, but **sweet spot from 65mA to 400mA**, mainly for 0.5W & 1W LEDs

Benefits
- Reasonable overall system cost
- Stable light emission
- Suitable for Pulse Width Modulation (PWM), possibility of LED dimming
- Negative temperature coefficient serves as protection for LEDs at higher temperatures

Recommended Power Transistors
- BCX65-25 (in SOT89 package), in mass production
- BC817SU (in SC74 package, samples available)
Pie Chart showing power dissipation in circuit elements. Note that ~ 70% of the available power (4008mW) is consumed in the Light Emitting Diodes.

Power Dissipation Budget, LED Driver Application Board +12V Supply, 334mA LED Current
( Three 1-Watt LEDs, White OSRAM "Golden Dragon" LW W5SM )
High Precision Controller for High Brightness LED’s - BCR450

> LED Drivers

- **Features**
  - Typ. 150mV voltage drop across Rsense
  - Current variation smaller than +/- 10% over the whole operating temperature range (-25 to 125°C)
  - Microcontroller enable input for PWM, **no Digital Transistor required**
  - Thermal shutdown (Tj = 150 ... 180 °C)
  - Operates up to 27 V

- **Benefits**
  - Lower part count
    - no digital transistor needed for microcontroller enable input for PWM
    - no capacitors needed to prevent oscillating
  - Higher number of LEDs in one branch due to low voltage drop
  - Protection of LEDs due to thermal shutdown
  - LED brightness constant over the temp range

- **Recommended Power Transistors**
  - BCX65-25 (SOT89)
  - BC817SU (SC74, samples available)

- **Samples for LED controller, April 2007, Volume, starting mid 2007**
## Application Note - AN101 based on existing products

### BCR401R
- **Voltage overhead**: min. 1.1V, using external power stage, $V_{ref} = 0.85$ V
- **Precision of Iout:**
  - ±10% initial (@ $V_s = 10$V; $T_j = 25^\circ$C)
  - + $V_{supply}$ variation (1 %/V)
  - + temperature coefficient ( -0.2 %/K)

### BCR450
- **Voltage overhead**: min. 0.4V, using external power stage, $V_{ref} = 0.15$ V
- **Precision of Iout:**
  +/− 10% in whole operating range ($V_{supply}$; $T_j$)
- **Thermal shutdown to protect lamp modules from thermal overstress**
- **Microcontroller compatible 'enable input' for PWM operation**

NEW!!! – Volume mid 2007

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Demo Board for High Current Applications using BCR450

> LED Drivers

optional: LUMILED LUXEON

optional: Booster Transistors
BC817SU

optional: OSRAM PowerTop-LED

optional: Advanced OSRAM PowerTop-LED

BCR450

OSRAM Golden Dragon

Booster Transistors BCX68-25
Summary

> LED Drivers

- Infineon small signal discretes offers a range of low cost LED drivers from 10mA up to 700mA.

- LED drivers can be used either
  -> as standalone drivers for currents 10mA to 65mA or
  -> as LED controller in combination with a booster transistor for currents from 65mA up to 700mA see AN101

- Main applications so far are
  -> neon bulb replacement for signage / advertising & accent lighting
  -> side markers at trucks, low cost applications in cars,
  -> big LED displays etc
  -> further cost sensitive applications

- The Infineon portfolio was further complemented by three new products, BCR401W, BCR402W and BCR401U in the low cost segment

- For higher requirements for LED drivers the new BCR450
  -> low voltage drop / high precision LED controller will be available in volume from mid 2007, samples available in April 2007
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- HiPAC, TVS Diodes, Silicon Microphone
- LED Drivers
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- AF Discretes
  - Introduction
    - Digital Transistors
    - General Purpose Transistors
    - General Purpose Diodes
Our Core Know-how is Used Across Many Applications

> AF Discretes > Introduction

**Automotive**
- Safety
- Power train
- Infotainment

**Digital Transistors**
**GP Transistors**
**GP Diodes**

**Consumer**
- Disc Drives
- PCMCIA
- Modems
- TV/VCR-Chassis
- Set-Top Box
- Digital Still Camera
- Camcorder
- Portable Audio
- Motherboards
- MP3

**Communication**
- Cordless Phones
- Mobile Phones
- Base Stations
- Disc Drives
- PCMCIA
- Modems
AF small signal discretes with higher value proposition

> AF Discretes > Introduction

**Digital transistors**
- 500mA digital transistors in SOT23 like BCR503, BCR521, BCR583 etc)

**AF transistors**
- Current mirror applications (BCV61 / BCV62)
- Precision matched current mirror (BCM846S / BCM856S)
- High voltage applications (BCV26,27,46,47 & BCX41,42)
- High current transistors (BDP9x)

**AF diodes**
- Low leakage diodes (BAS116, BAV170, 199, BAW156)
- BAS28 & BAW101 in SOT143 and BAS28W SOT343
- High reverse voltage BAW78 & BAW79
- Bridge rectifier BGX50A

**General**
- Double die packages SOT363 & SC74 like BAV99S, BC847PN, BCR133S, BAS21U, BC817UPN, BC807U, BCR523U, and many others)

→ Look for applications for these products and promote strongly these products
Table of Contents

- AF Discretes
  - Introduction
- Digital Transistors
  - General Purpose Transistors
- General Purpose Diodes
Higher value proposition

- Double die packages SOT363 & SC74 like BCR133S, BCR08PN, BCR523U etc)
  Main application: Automotive, Industry other
  Major competition: Rohm, NXP, ON Semi

- 500mA single die package SOT23 like BCR503, BCR521, BCR583 etc)
  Main application: Automotive, Industry other
  Major competition: Rohm, NXP, ON Semi

→ 1st priority for promotion

100mA single die package SOT23 like BCR108, BCR133, BCR183 etc)
Main application: Automotive, Industry other
Major competition: Rohm, NXP

→ 2nd priority for promotion
## Digital Transistors Single Chip Versions

> AF Discretes > Digital Transistors

<table>
<thead>
<tr>
<th>R1 (kOhm)</th>
<th>R2 (kOhm)</th>
<th>SOT23 V&lt;sub&gt;c80&lt;/sub&gt; 50V, I&lt;sub&gt;c&lt;/sub&gt; 100mA</th>
<th>SOT323 V&lt;sub&gt;c80&lt;/sub&gt; 50V, I&lt;sub&gt;c&lt;/sub&gt; 100mA</th>
<th>SOT23 V&lt;sub&gt;c80&lt;/sub&gt; 50V, I&lt;sub&gt;c&lt;/sub&gt; 100mA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>nnp</td>
<td>pnp</td>
<td>nnp</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>---</td>
<td>---</td>
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</tr>
<tr>
<td>2.2</td>
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<td>BCR103</td>
<td>BCR153</td>
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<td>BCR116W</td>
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<td>BCR119</td>
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<td>BCR119W</td>
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<td>---</td>
<td>---</td>
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<tr>
<td>10</td>
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<td>BCR129</td>
<td>---</td>
<td>BCR129W</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>BCR133</td>
<td>BCR183</td>
<td>BCR133W</td>
</tr>
<tr>
<td>10</td>
<td>47</td>
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<td>BCR185</td>
<td>BCR135W</td>
</tr>
<tr>
<td>22</td>
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<td>BCR139</td>
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<td>BCR191</td>
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<td>22</td>
<td>47</td>
<td>BCR142</td>
<td>BCR192</td>
<td>BCR142W</td>
</tr>
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<td>22</td>
<td>BCR146</td>
<td>BCR196</td>
<td>BCR146W</td>
</tr>
<tr>
<td>47</td>
<td>47</td>
<td>BCR148</td>
<td>BCR198</td>
<td>BCR148W</td>
</tr>
</tbody>
</table>

Not listed resistor values / combinations can be offered on demand

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### Digital Transistors Multichip Versions

> AF Discretes > Digital Transistors

<table>
<thead>
<tr>
<th>R1</th>
<th>R2</th>
<th>SOT363 Dual digital transistor array (V\text{CEO} = 50\text{V}; \text{I}_\text{C} = 100\text{mA})</th>
<th>SC74 Dual digital transistor array (V\text{CEO} = 50\text{V}; \text{I}_\text{C} = 500\text{mA})</th>
</tr>
</thead>
<tbody>
<tr>
<td>[kOhm]</td>
<td>[kOhm]</td>
<td>2 npn 2 pnp</td>
<td>npn + pnp</td>
</tr>
<tr>
<td>2,2</td>
<td>2,2</td>
<td>BCR108S</td>
<td>BCR08PN</td>
</tr>
<tr>
<td>2,2</td>
<td>47</td>
<td>BCR110S</td>
<td>BCR08PN</td>
</tr>
<tr>
<td>4,7</td>
<td>4,7</td>
<td>BCR116S</td>
<td></td>
</tr>
<tr>
<td>4,7</td>
<td>47</td>
<td>BCR116S</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>BCR119S</td>
<td>BCR169S</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>BCR129S</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>47</td>
<td>BCR133S</td>
<td>BCR183S</td>
</tr>
<tr>
<td>10</td>
<td>47</td>
<td>BCR135S</td>
<td>BCR185S</td>
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<td>47</td>
<td>22</td>
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<td>2,2</td>
<td>47</td>
<td>pnp</td>
<td></td>
</tr>
</tbody>
</table>

Not listed resistor values / combinations can be offered on demand
# Table of Contents

- **AF Discretes**
  - Introduction
  - Digital Transistors
- **General Purpose Transistors**
- **General Purpose Diodes**
Higher value proposition with General Purpose Transistors

> AF Discretes > General Purpose Transistors

**Higher value proposition**

- Double die packages SOT363 & SC74 (BC846S, BC847PN, BC817UPN, BC807U etc)
  
  **Main application:** Automotive, Industry other  
  **Major competition:** NXP, ON Semi, other

- Current mirror applications (BCV61 / BCV62)
  
  **Main application:** Automotive, Industry other  
  **Major competition:** NXP, ON Semi, other

- Precision matched current mirror (BCM846S / BCM856S)
  
  **Main application:** Automotive, Industry other  
  **Major competition:** NXP

- High voltage applications (BCV26,27,46,47 & BCX41,42)
  
  **Main application:** Automotive, Industry other  
  **Major competition:** NXP

- High current transistors (BDP9x)
  
  **Main application:** Telecommunication  
  **Major competition:** Zetex

→ 1st priority for promotion
## General Purpose AF Transistors

### > AF Discretes > General Purpose Transistors

<table>
<thead>
<tr>
<th>Package</th>
<th>SOT89</th>
<th>SOT223</th>
<th>SOT23</th>
<th>SOT323</th>
<th>SOT143</th>
<th>SOT363</th>
<th>SC74</th>
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<tr>
<td><strong>Current Mirror</strong></td>
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<td></td>
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<td>BCV61</td>
<td>BC846S</td>
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<td>BCV62</td>
<td>BC856S</td>
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<td><strong>Precision matched current mirror</strong></td>
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<td><strong>Low Noise Transistors</strong> (Noise Figure &lt;4dB@1kHz)</td>
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<td><strong>Darlington</strong> (h(\text{FE}&gt;2000))</td>
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<td><strong>Fast switching</strong> (Storage time &lt;1µs)</td>
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<td><strong>High Voltage</strong> (V(\text{CEO}&gt;100V))</td>
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</tbody>
</table>
BCM846S / BCM856S
Matched Dual Transistor Arrays

> AF Discretes > General Purpose Transistors

Features
- $\pm 10\%$ ΔIc matching in current mirror circuit
- $V_{ce0} > 65\ \text{V}$
- $I_c = 100\ \text{mA}$
- $h_{FE} = 200 - 450$

Ideal for:
- Current mirror circuits
- Current-sense applications
- Discrete Voltage regulators

Available as:
- NPN (BCM846S) and PNP (BCM856S)
- Small footprint (SOT363)
- Application slides available
Table of Contents

■ AF Discretes
  ■ Introduction
  ■ Digital Transistors
  ■ General Purpose Transistors
  ■ General Purpose Diodes
Functionalities

- Rectifier
- Switching / High Speed switching
- Circuit protection

Requirements

- High voltage diodes ($V_R$)
- Low leakage current ($I_R$)
- High variation of allowable current ($I_F$)
- Fast recovery time (trr)
- Small diode capacitance (CT)
- Small packages and more elements / package
Broad AF Diode product portfolio
Customer can optimize Reverse Current vs Reverse Voltage

> AF Discretes > General Purpose Diodes

Leakage current vs. Reverse voltage

(at 25°C)

High value proposition, Less commoditized market

0,001 0,01 0,1 1 10
0 50 100 150 200 250 300 350 400 450 500
VR (V)

IR (µA)
Higher value proposition with General Purpose Diodes

> AF Discretes > General Purpose Diodes

**Higher value proposition**

- Multiple (>2) die packages SOT363 & SC74 (BAV70S, BAV99S, BAW56S, BAS16S, BAS21U etc)
  - **Main application:** Automotive, Industry other
  - **Major competition:** NXP, ON Semi, other

- Low leakage diodes (BAS116, BAV170, 199, BAW156)
  - **Main application:** Automotive, Consumer, other especially high temperature applications to limit leakage current and avoid battery discharge
  - **Major competition:** NXP

- BAS28 & BAW101 in SOT143 and BAS28W SOT343
  - **Main application:** Automotive, Industry other two galvanically isolated diodes, BAS28 for 100V, BAW101 for 300V reverse voltage
  - **Major competition:** NXP

- High reverse voltage BAW78 & BAW79 (400V, 1A)
  - **Main application:** Rectifier diode for Automotive, Industry other
  - **Major competition:** NXP

- Bridge rectifier BGX50A
  - **Main application:** Rectifier for Automotive, Industry other
  - **Major competition:** NXP

→ **1st priority for promotion**
Infineon offers a variety of General Purpose Diodes

- Today > 60 types
- Available in different packages and configurations
- Customer can choose ideal product for specific application

<table>
<thead>
<tr>
<th>Type</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Speed switching Diodes</td>
<td>$V_R \leq 100\text{V} \ ; \ I_F \leq 250\text{mA} \ ; \ I_R &lt; 500\text{nA} \ ; \ t_{rr} &lt; 4\text{ns}$</td>
</tr>
<tr>
<td>Switching Diodes</td>
<td>$V_R \leq 300\text{V} \ ; \ I_F \leq 250\text{mA} \ ; \ I_R &lt; 150\text{nA} \ ; \ t_{rr} &lt; 1\text{µs}$</td>
</tr>
<tr>
<td>Low Leakage Diodes</td>
<td>$V_R = 80\text{V} \ ; \ I_F \leq 250\text{mA} \ ; \ I_R &lt; 5\text{nA} \ ; \ t_{rr} &lt; 1.5\text{µs}$</td>
</tr>
<tr>
<td>Rectifier Diodes</td>
<td>$V_R = 400\text{V} \ ; \ I_F = 1\text{A} \ ; \ I_R &lt; 1\text{µA}$</td>
</tr>
<tr>
<td>Bridge Rectifier Diodes</td>
<td>$V_R = 50\text{V} \ ; \ V_{RM} = 70\text{V (peak)} \ ; \ I_F = 140\text{mA}$</td>
</tr>
</tbody>
</table>
Application Power Supply

<table>
<thead>
<tr>
<th>Product</th>
<th>V_{rmax}/ V</th>
<th>I_{fmax}/ mA</th>
<th>V_{BR}/ V</th>
<th>I_{R}/ µA</th>
<th>@ V_{R}/ V</th>
<th>V_{F}/ V</th>
<th>@ f / mA</th>
<th>rr</th>
</tr>
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<tbody>
<tr>
<td>BGX50A</td>
<td>50</td>
<td>140</td>
<td>50</td>
<td>&lt; 0.20</td>
<td>50</td>
<td>&lt; 2.60</td>
<td>100</td>
<td>&lt; 6.0 ns</td>
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<tr>
<td>BGX400</td>
<td>400</td>
<td>250</td>
<td>&gt;400</td>
<td>&lt; 1.00</td>
<td>400</td>
<td>&lt; 2.00</td>
<td>2000</td>
<td>&lt; 1.0 µs</td>
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</table>
### General Purpose Diodes

**AF Discretes > General Purpose Diodes**

<table>
<thead>
<tr>
<th>Device Family</th>
<th>V R [V]</th>
<th>I F [mA]</th>
<th>Configuration</th>
<th>SOT 143 / SC61</th>
<th>SOT 363 / SC88</th>
<th>SC 74</th>
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</thead>
<tbody>
<tr>
<td>g.p. diodes for rectifying and switching &amp; clamping</td>
<td>50</td>
<td>140</td>
<td>fullbridge rectifier</td>
<td>BGX 50 A</td>
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<tr>
<td></td>
<td>70</td>
<td>200</td>
<td>dual 2* comm. Cathode</td>
<td>BAV 70 S</td>
<td>BAV 70 U</td>
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<tr>
<td></td>
<td>75</td>
<td>250</td>
<td>Three parallel</td>
<td>BAS 16 S</td>
<td>BAS 16 U</td>
<td></td>
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<tr>
<td></td>
<td>70</td>
<td>200</td>
<td>dual 2* series connected</td>
<td>BAV 99 S</td>
<td>BAV 99 U</td>
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<td>70</td>
<td>200</td>
<td>dual 2* comm. Anode</td>
<td>BAS 56 S</td>
<td>BAS 56 U</td>
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<tr>
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<td>200</td>
<td>250</td>
<td>Three parallel</td>
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<td>BAS 21 U</td>
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</table>

![Diagrams of diode configurations](image-url)
### Switching and Rectifier Diodes

> AF Discretes > General Purpose Diodes

**Three basic types - Different packages and configurations!**

**Main Application:** Switching, where high breakdown voltage is needed

→ e.g. modems

<table>
<thead>
<tr>
<th>Product</th>
<th>VRmax</th>
<th>IFmax</th>
<th>IFSmax</th>
<th>IR @VRmax</th>
<th>VF</th>
<th>@ IF</th>
<th>CT</th>
<th>trr</th>
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<tbody>
<tr>
<td>BAS21xx</td>
<td>200 V</td>
<td>250 mA</td>
<td>4.5 A</td>
<td>&lt; 100 nA</td>
<td>&lt; 1.25 V</td>
<td>200 mA</td>
<td>&lt; 5 pF</td>
<td>&lt; 50 ns</td>
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<td>BAW101</td>
<td>300 V</td>
<td>250 mA</td>
<td>4.5 A</td>
<td>&lt; 150 nA</td>
<td>&lt; 1.3 V</td>
<td>100 mA</td>
<td>6 pF</td>
<td>1 µs</td>
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<td>BAW78xx</td>
<td>400 V</td>
<td>1 A</td>
<td>10 A</td>
<td>&lt; 1 µA</td>
<td>&lt; 1.6 V</td>
<td>1 A</td>
<td>10 pF</td>
<td>1 µs</td>
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### Low Leakage Diodes

#### General Purpose Diodes

One basic type - Different packages and configurations!

Main Application: Low leakage switching applications especially high temperature applications

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<thead>
<tr>
<th>Product</th>
<th>VR$<em>{r</em>{\text{max}}}$</th>
<th>IF$_{\text{max}}$</th>
<th>IFS$_{\text{max}}$</th>
<th>IR$_{\text{max}}$ @VR=75V</th>
<th>VF</th>
<th>@ IF</th>
<th>CT</th>
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<td>BAS116</td>
<td>80 V</td>
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<td>&lt; 1.25 V</td>
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<td>2 pF</td>
<td>&lt; 3 $\mu$s</td>
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</table>
High Speed Switching Diodes
Mainly commodity parts

> AF Discretes > General Purpose Diodes

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<th>VRmax</th>
<th>IFmax</th>
<th>IFSmax</th>
<th>IR @ Vrmax</th>
<th>VF</th>
<th>@ IF</th>
<th>CT</th>
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<td>100 ... 150 mA</td>
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<td>&lt; 4 ns</td>
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</table>

One basic type - Different packages and configurations!
Main Application: High Speed Switching
Summary AF discretes

> AF Discretes

- Not all AF products are pure commodity, there are some products that offer higher value to customer

- For AF discretes rather than small packages like SC75, TSFP & TSLP double / triple die packages seem to provide higher value to the customer like saving board space

- Also current mirror applications, higher voltage and high current or high power components seem to be less commoditized and herewith under less price pressure
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- General Information
- Packages
- Internet Navigation
- Application Notes
- Nomenclature
- MatQ
# Packages for Silicon Discretes

> General Information > Packages

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<td>Leadless</td>
<td>TSLP-2-1</td>
<td>TSLP-4-3</td>
<td>TSLP-4-4</td>
<td>TSLP-2-7 (RH*)</td>
<td>TSLP-7-4</td>
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<td>TSLP-3-1/4</td>
<td>TSLP-6-1</td>
<td>TSLP-7-1</td>
<td>TSLP-4-7 (RH*)</td>
<td>TSLP-3-7/8 (RH*)</td>
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<td>Flatlead</td>
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<td>SCD80</td>
<td>SC79</td>
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<td>Gullwing</td>
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<td>SOT223</td>
<td>SOD323</td>
<td>SOT323</td>
<td>SOT343</td>
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* Reduced Height 0.4mm max.
** Low Height 0.32mm max.
Diode packages on the way for smallest size

> General Information > Packages

- **TSLP**
  - TSLP-2/3/4
  - Package Height: 0.50 mm max.
  - Sizes: 1.0 x 0.6 x 0.4 mm / 1.2 x 0.8 x 0.4 mm

- **TSLP-RH**
  - TSLP-2/3/4-RH
  - Reduced Height: 0.40 mm max.
  - Sizes: 1.0 x 0.6 x 0.39 mm / 1.2 x 0.8 x 0.39 mm

- **TSSLP**
  - TSSLP-2
  - Package Height: 0.32 mm max.
  - Sizes: 0.6 x 0.3 x 0.31 mm

**2003**

**2004**

**2005**

20% height reduction

70% footprint reduction
20% height reduction
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www.infineon.com/smallsignaldiscretes

www.infineon.com/rfmmics

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www.infineon.com/tvsvdiodes

www.infineon.com/lowcostleddriver

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Diodes

BA… PIN / Switching diodes, mainly for Consumer market
BB… Varactor diodes, mainly for Consumer market
BAR… PIN diodes, mainly for Mobile Comm market
BAS…/ BAT… Schottky diodes
BBY… Varactor diodes for VCO application
ESD… TVS and ESD protection diodes

Varactor Diodes Tuner Applications

SOD323  SCD80  SC79

BB639 → +20 = BB659 + ext.02V BB659-02V
BB535 → +20 = BB555 + ext.02V BB555-02V
... ... ...
## Transistors

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<td>BF...</td>
<td>RF MOSFETs or Bipolar Transistor. Mainly for consumer application</td>
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<td>BG...</td>
<td>Dual RF MOSFETs in SOT363</td>
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<td>BFR...</td>
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<td>BFP...</td>
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<td>BFS...</td>
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<td>BFG...</td>
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<td>BC...</td>
<td>AF Transistor</td>
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<td>BCR...</td>
<td>AF Transistor with built in resistors (=Dual Transistor)</td>
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<td>BCR1xx</td>
<td>$100\text{mA}$ types, BCR5xx = $500\text{mA}$ types. (&lt;150 = NPN; &gt;149 = PNP)</td>
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<td>BCR4....</td>
<td>AF Small Scale Integrated Circuits SSIC</td>
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<td>SIEGET®</td>
<td>BFP4xx, BFP5xx series (Siemens Grounded Emitter Transistor)</td>
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<td>SiGe:C</td>
<td>BFP7xx series (Silicon Germanium Carbon Transistor)</td>
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Extensions

R  Reverse pining
    !!! SOT343 is always in reverse pining, i.e. there is no e.g. BF2030RW !!!
W  Next smaller package e.g. BFR181 (SOT23) → BFR181W (SOT323)
    !!! SIEGETs are in SOT343 but have no “W” as there are no SIEGETs in SOT143 !!!
S  SOT363 package
T  SC75 package
U  SC74 package
F  Flat lead package (TSFP3/4)
RH Reduced Height version of TSLP package (max. 0.4 mm)
L3LH Low Height version of 3pin transistor TSLP package (max. 0.32 mm max.)
-02V / -02W Diodes in SC79 / SCD80 package
-02L / -02LRH / -02LS Diodes in TSLP2 / TSLP2-RH / TSSLP package
-07LRH/098LRH/099LRH Dual Diodes in TSLP4-RH package
-03W SOD323 package (for IT and AF diodes)
-04 / 05 / 06 Dual diodes in SOT23 package (series/com. cath/com. anod.)
-04W / 05W / 06W Dual diodes in SOT323 package (series/com. cath/com. anod.)
-07 / -07W Dual diodes in SOT143 / SOT343 package (parallel)
PN Dual transistors (1pnp + 1 npn) in one package

Further extensions for AF components

A, B, C, … or Current gain groups (same chip), e.g. BC846A, BC846B,…
-16, -25, -40
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How are materials declared?

- Substances and materials contained in IFX products are declared via Umbrella Specification (U-Spec) in accordance to IEC 61906

- The U-Spec declares full materials present in Infineon product(s) in concentrations above 0.1 % by weight (1000 ppm).

- Trace concentrations of materials (i.e. those < 0.1 % by weight) present in products are marked with an "X" if they are intentionally added substances-of-concern (e.g. CEFIC-EECA-EICTA).

How to obtain U-Specs?

- Please contact your Infineon Sales interfacing unit
Infineon products DO NOT contain

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<td>[x] Cr</td>
<td>[x] Cd</td>
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polybrominated diphenylethers (PBDE)

polybrominated biphenyls (PBB)


Lead (Pb)

is currently being phased out in our Green conversion strategy
(www.infineon.com – product – packages)
Declarations

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What declarations and statements are currently available?

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For these, please contact your Infineon interfacing unit

www.infineon.com/matq
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