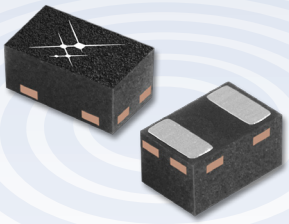
Applications

- High isolation switching
- Detection
- Mixing
- Voltage control
- Tuning
- Phase shifting
- Receiver protection

Features

- Low parasitic inductance 0.45 nH
- Low thermal impedance 50° C/W
- Small form factor 1.0 x 0.6 x 0.46 mm
- 10 MHz–12 GHz



SKYWORKS®
BREAKTHROUGH SIMPLICITY

Miniature 0402 Surface Mount Technology Packaged RF Diodes

Skyworks offers a variety of 0402 surface mount technology (SMT) diodes including PIN diodes for switch and attenuator applications, limiter diodes for receiver protection applications, Schottky diodes for detector and mixer applications and tuning varactor diodes for VCO, voltage tuned filters and phase shifter applications. These small form factor devices offer low parasitic inductance and low thermal impedance, making them ideal for a variety of markets including WLAN, WiMAX, cellular handset, cellular infrastructure, automotive, CATV/Satcom, smart energy, medical, military, RFID, and test and measurement.

PIN Diodes for Switch and Attenuator Applications

Feature/Application	Characteristics	Part Number
High Isolation Switching	Very Low Capacitance (0.13 pF), Isolation 40 dB	SMP1345-040LF
Fast Switching/High Isolation	Low Capacitance, Fast Switching	SMP1340-040LF
High Isolation	Low Capacitance	SMP1321-040LF
Moderate Power Switching	Low Capacitance, Low Resistance	SMP1320-040LF
High Power Switching	Low Distortion	SMP1352-040LF

Limiter Diodes for Receiver Protection Applications

Feature/Application	Characteristics	Part Number
Low Capacitance, Low Threshold Level	Fast Recovery Time (5 ns Typ.)	SMP1330-040LF

Schottky Diodes for Detector and Mixer Applications

Feature/Application	Characteristics	Part Number
High Sensitivity Detector	Low Barrier Height, Low Capacitance	SMS7621-040LF
Most Sensitive Detector	Lowest Barrier Height, Low Capacitance	SMS7630-040LF

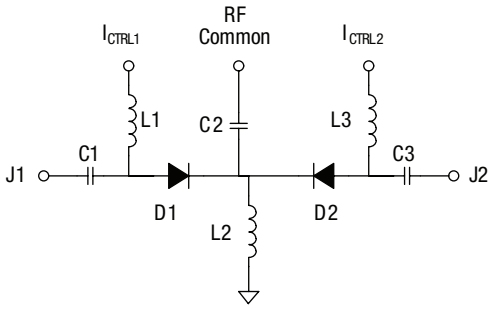
Tuning Varactor Diodes for VCO, Voltage Tuned Filters and Phase Shifter Applications

Feature/Application	Characteristics	Part Number
Low Capacitance, High Q	Capacitance (7 pF @ 0.3 V, 0.7 pF @ 4.7 V), Q (1500)	SMV1247-040LF
Low Capacitance, Low R_S	Capacitance (6.7 pF @ 0.5 V, 2.6 pF @ 1.5 V), R_S (0.7 Ω)	SMV1763-040LF
High Capacitance and Tuning Range	Capacitance (31 pF @ 0.3 V, 2.6 @ 4.7 V), CTR (12:1)	SMV1249-040LF

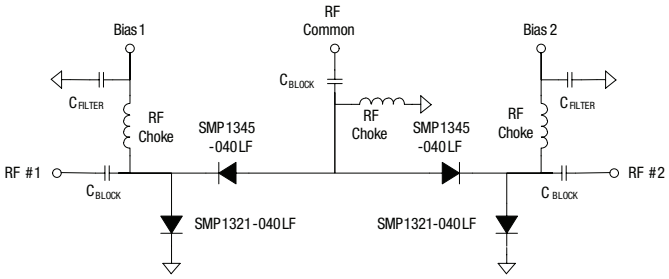
PIN Diodes

PIN diodes are some of the most widely used diodes in the world and range in applications from RF switching in satellite television receiver low noise block converters (LNB), to automotive remote garage door openers, to land mobile radio transceivers and cable television automatic level controls.

PIN diodes are three layer diodes, comprised of a heavily doped anode (the "P" layer) and a heavily doped cathode (the "N" layer) separated by a virtually undoped intrinsic layer (the "I" layer). Under forward bias, charge carriers from the P and the N layers are forced into the I layer, which reduces its RF impedance. When a reverse bias voltage is applied across the PIN diodes, all free charge carriers are removed from the I layer, thereby causing its RF impedance to increase. This variable RF impedance versus DC, or low frequency bias signal, allows the diode to be used in RF switching circuits in which the PIN diode is either heavily forward-biased or reverse biased. In RF attenuation circuits, the PIN diode is utilized as a continuously-variable RF resistance by controlling the magnitude of the DC bias current through the diode.



Wide Bandwidth Single Pole Double Throw Switch

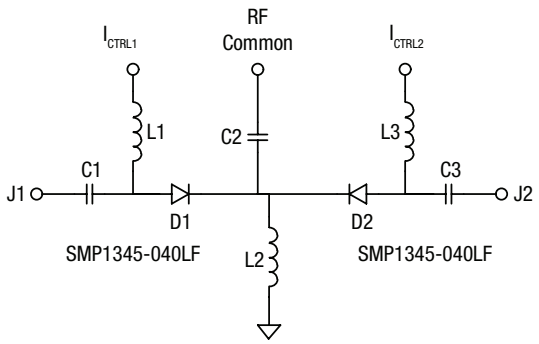


High Isolation PIN Diode Single Pole Double Throw Switch

Switching Applications

The circuit below shows a pair of PIN diodes used to form a single pole, double throw switch. In this switch, a positive control current typically of the order of 10 mA is applied to one of the bias inputs to place that side of the switch into its low insertion loss state, while a negative bias voltage is applied to the other bias input, forcing the diode on that side of the switch into its maximum RF impedance state to produce high isolation on that side of the switch.

Many other switching circuit variations exist. Please refer to "Design with PIN Diodes" available on our Web site at www.skyworksinc.com for more information.

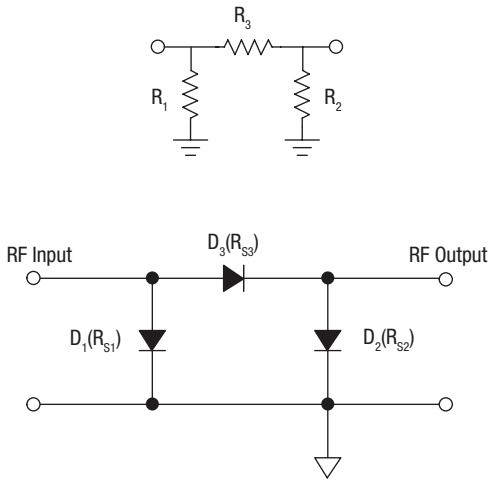


Typical SPDT Switch

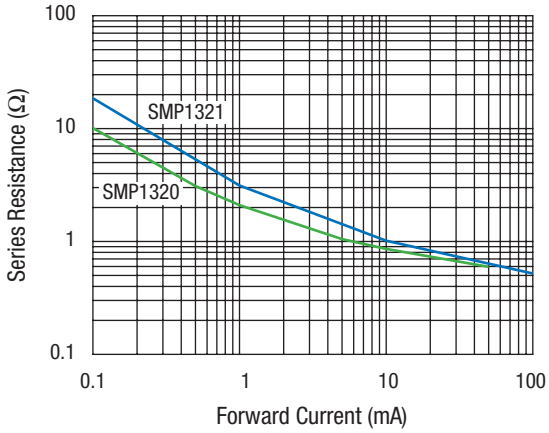
Attenuation Applications

A resistive attenuator can be built utilizing one or more PIN diodes. In this type of circuit, the RF resistance of the PIN diode is adjusted to a desired value by varying the magnitude of the DC bias current applied to the diode. This resistance produces attenuation.

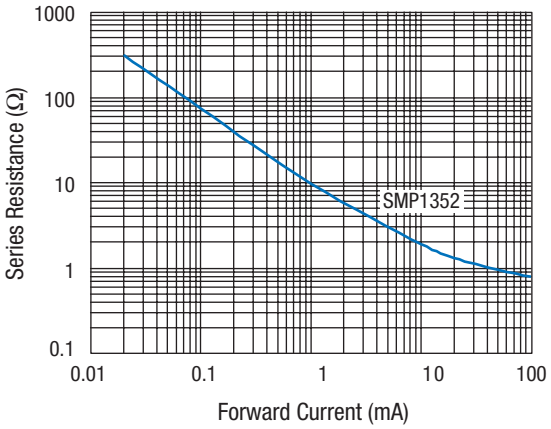
The diagrams below show an attenuator that utilizes three PIN diodes. Many other PIN diode circuit configurations are also possible. Please refer to "Design with PIN Diodes" available on our Web site at www.skyworksinc.com for more information.



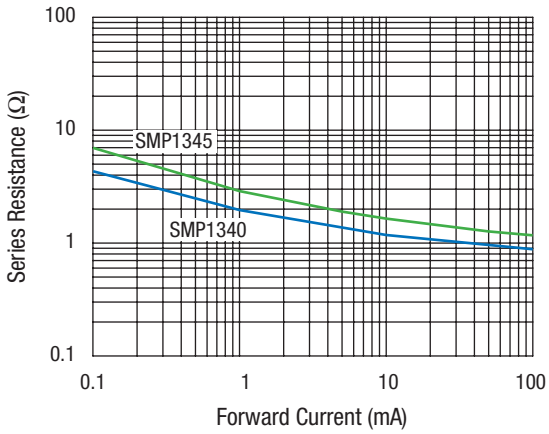
Pi Attenuator



Series Resistance vs. Forward Current



Series Resistance vs. Forward Current



Series Resistance vs. Forward Current

PIN Diodes for Switch and Attenuator Applications

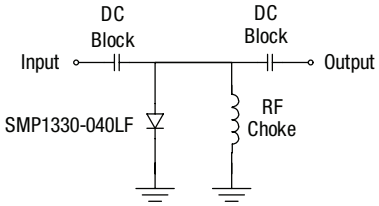
Product Description	Key Features	Part Number
High Isolation Switching PIN Diode	Very Low Capacitance 0.14 pF, Isolation 40 dB	SMP1345-040LF
Fast Switching/High Isolation PIN Diode	Low Capacitance, Low Series Resistance	SMP1340-040LF
High Isolation (LNB/Multiswitch) PIN Diode	Low Capacitance, Series Pair	SMP1321-040LF
Moderate Power Handling	Low Capacitance, Low Resistance	SMP1320-040LF
High Power Switching	Lower Distortion	SMP1352-040LF

Electrical Specifications

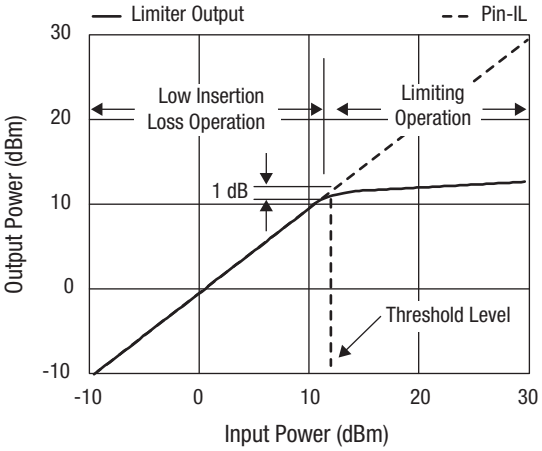
Part Number	Max. V_R I_R = 10 µA (V)	C_T V_R = 30 V (pF)	C_T V_R = 5 V (pF)	C_T V_R = 20 V (pF)	Typ. V_F I_F = 10 mA (V)	R_S I_F = 1 mA F = 100 MHz (Ω)	Max. R_S I_F = 10 mA F = 100 MHz (Ω)	R_S I_F = 100 mA F = 100 MHz (Ω)	Typ. Carrier Lifetime I_F = 10 mA (ns)
SMP1345-040LF	50	–	0.20 Max.	–	0.89	3.5 Typ.	2.0	–	100
SMP1340-040LF	50	–	0.30 Max.	–	0.85	–	1.2	–	100
SMP1321-040LF	100	0.025 Max.	–	–	0.85	3.0 Typ.	2.0	–	400
SMP1320-040LF	50	0.25 Max.	–	–	0.85	2.0 Typ.	0.9	–	400
SMP1352-040LF	200	–	–	0.30 Max.	0.80	15 Max.	2.8	1.35 Max.	1000

Limiter Diodes

The PIN limiter diode can be described as an incident power controlled, variable resistor. In the case when no large input signal is present, the impedance of the limiter diode is at its maximum, thereby producing minimum insertion loss, typically less than 0.5 dB. The presence of a large input signal temporarily forces the impedance of the diode to a much lower value, producing an impedance mismatch which reflects the majority of the input signal power back towards its source.



A Single Stage Limiter



Output Power vs. Input Power for a Single Stage Limiter

Limiter Diodes for Receiver Protection Applications

Feature/Application	Characteristics	Part Number
Low Capacitance, Low Threshold Level	Fast Recovery Time (5 ns Typ.)	SMP1330-040LF

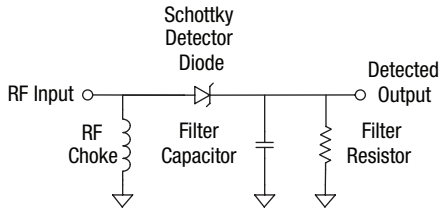
Electrical Specifications

Part Number	V_B I_R = 10 µA (V)	I Region Thickness (µm) Nominal	C_T (pF) 0 V, F = 1 MHz	C_T (pF) 0 V, F = 1 GHz	R_S I_F = 10 mA F = 100 MHz (Ω)	Carrier Lifetime T_L (ns) IF = 10 mA
SMP1330-040LF	20–50	2	0.7 Typ., 1.0 Max.	0.7 Typ.	1.25 Typ., 1.9 Max.	4.0 Typ.

Schottky Diodes

Schottky diodes are optimized for use in detector and mixer applications at frequencies from below 10 MHz to higher than 20 GHz. Skyworks' family of products include medium, low and zero bias detector (ZBD) barrier height Schottky junctions with low junction capacitance and low series resistance.

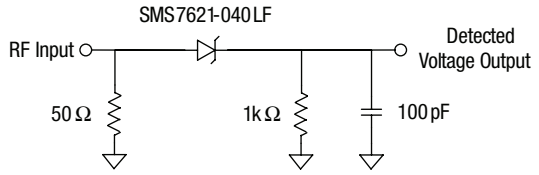
Schottky junctions are formed by depositing specific metals on either n-doped silicon (low or medium barrier height) or on p-doped silicon (ZBD barrier height). The characteristics of the diode are determined by the type of metal deposited on the semiconductor material, as well as the type of dopant in the semiconductor layer, among other parameters.



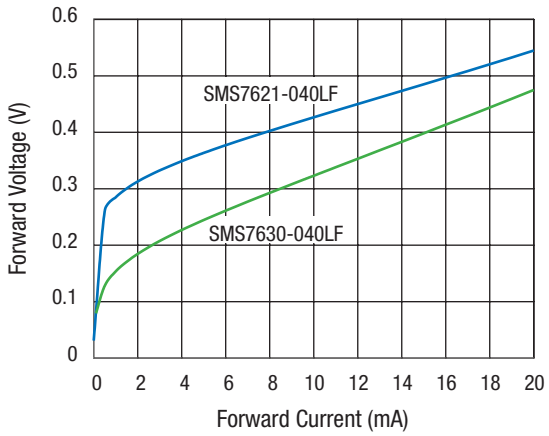
Single Schottky Diode Detector

SMS7621-040LF Schottky Detector Diode

The SMS7621-040LF combines low capacitance (nominally 0.2 pF) and low barrier height to produce a detector diode with excellent sensitivity.



Broadband Detector Circuit



Forward Voltage vs. Forward Current

Schottky Diodes for Detector and Mixer Applications

Feature/Application	Characteristics	Part Number
High Sensitivity Detector	Low Barrier Height and Low Capacitance	SMS7621-040LF
Most Sensitive Detector	Lowest Barrier Height, Low Capacitance	SMS7630-040LF

Electrical Specifications

Part Number	V_B I_R = 10 µA (V)	Max. V_F I_F = 1 mA (mV)	Max. C_T V_R = 0 V (pF)	Typ. R_T I_F = 5 mA F = 100 MHz (Ω)	Typ. R_V (Ω)
SMS7621-040LF	2 Min.	320	0.25	18	–
SMS7630-040LF	1 Min.*	240	0.35	–	5k

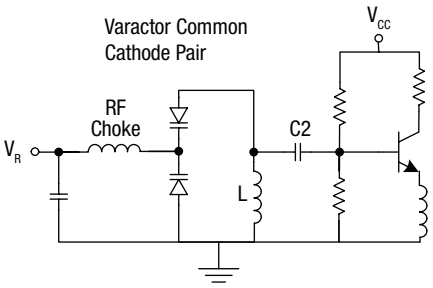
*I_R = 100 µA

Tuning Varactor Diodes

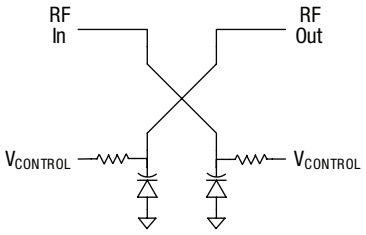
Skyworks series of silicon tuning varactor diodes are used as the electrical tuning elements in voltage controlled oscillators (VCOs), voltage variable analog phase shifters and voltage tuned filters (VTFs). This family of diodes includes abrupt junction tuning varactors, useful for low loss, narrow band circuits, and hyperabrupt junction varactors, useful for wide bandwidth VCOs and VTFs as well as wide phase range variable phase shifters.

Tuning varactors are PN junction diodes. The depletion region that forms at the junction of the diode acts as a nearly-ideal insulator, which separates the highly-doped anode from the cathode layer, thus forming a parallel plate capacitor. The thickness of the depletion layer can be increased by applying a reverse bias voltage to the diode.

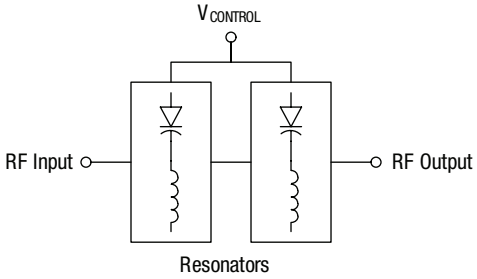
The cathode layer's doping profile is very carefully designed to produce a tightly controlled capacitance versus reverse bias voltage performance characteristic. The cathode layer of an abrupt junction diode has uniform dopant concentration throughout its thickness, which results in a low series resistance and moderately large change in capacitance versus bias voltage. By contrast, the doping concentration of cathode layer of hyperabrupt varactor diode is designed to change by several orders of magnitude, typically over the depth of a few microns. This non-constant dopant concentration versus depth of the hyperabrupt diode's cathode layer produces a much larger available change in capacitance versus reverse voltage, necessary for wide bandwidth or phase shift range applications.



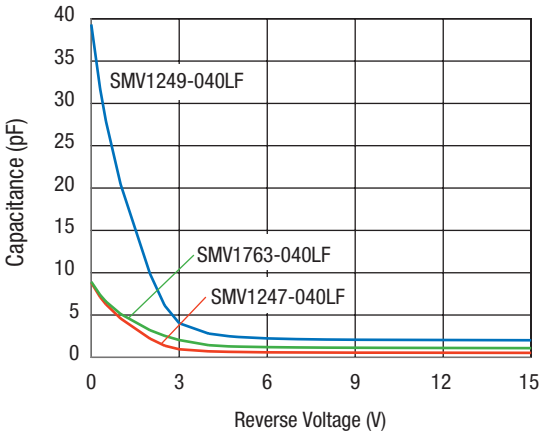
Typical Voltage Controlled Oscillator with a Common Cathode Pair of Tuning Varactors



Phase Shifter Diagram



Voltage Tuned Filter Diagram



Capacitance vs. Reverse Voltage

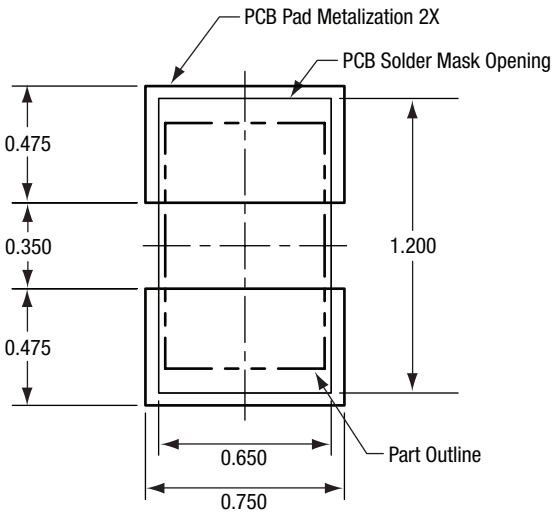
Tuning Varactor Diodes for VCO, Voltage Tuned Filters and Phase Shifter Applications

Feature/Application	Characteristics	Part Number
Low Capacitance, High Q	Capacitance (7 pF @ 0.3 V, 0.7 pF @ 4.7 V), Q (1500)	SMV1247-040LF
Low Capacitance, Low R_S	Capacitance (6.7 @ 0.5 V, 2.6 pF @ 1.5 V), R_S (0.7 Ω)	SMV1763-040LF
Wide Tuning Range	Capacitance (31 pF @ 0.3 V, 2.6 @ 4.7 V), CTR (12:1)	SMV1249-040LF

Electrical Specifications

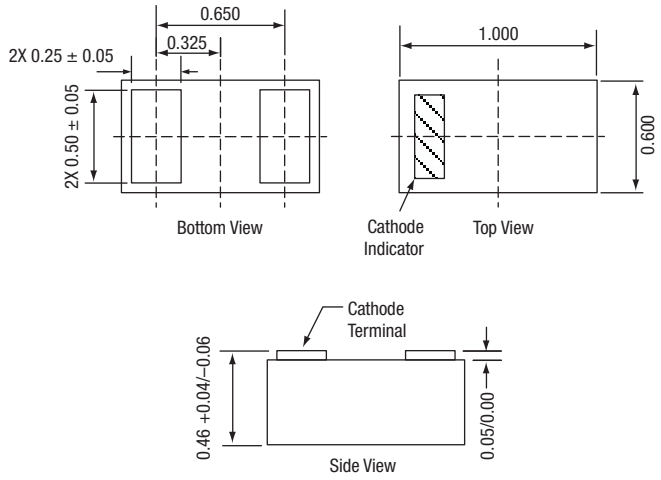
Part Number	Min. Reverse Breakdown Voltage, V_R I_R = 10 µA (V)	Typ. Total Capacitance[3], C_T V_R = 1 V (pF)	Typ. Total Capacitance[3], C_T V_R = 4 V (pF)	Typ. Total Capacitance[3], C_T V_R = 8 V (pF)	Min. Total Capacitance Ratio	Capacitance Ratio Range (V)	Max. Series Resistance, R_S (Ω)
SMV1247-040LF	15	4.4	0.77	0.64	9.5	0.3 to 4.7	2.6 @ 3.0 V
SMV1763-040LF	10	5.13	1.44	1.15	2.3	0.5 to 2.5	0.7 @ 1.0 V
SMV1249-040LF	15	18.2	2.70	2.0	11.0	0.3 to 4.7	1.2 @ 3.0 V

0402 Package Information



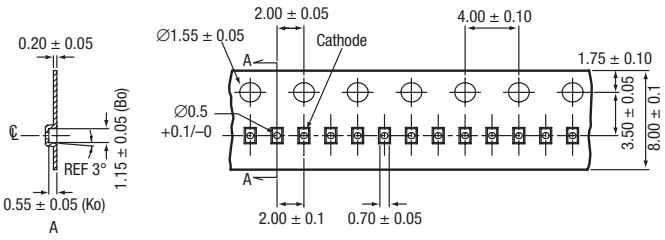
All measurements in millimeters **S1997**

PCB Layout Footprint



All dimensions in millimeters S1892

Package Dimensions



Notes:
1. *Cumulative tolerance of 10 sprocket holes is ±0.20 mm.*
2. *All dimensions are in millimeters*

S1922

Tape and Reel Dimensions

Green Initiative™

Through our Green Initiative,™ we are committed to manufacturing products that comply with global government directives and industry requirements.

Skyworks is continuously innovating RF, analog and mixed-signal ICs. For the latest product introductions and information about Skyworks, visit our Web site at **www.skyworksinc.com**

For additional information on our broad overall product portfolio, please contact your local sales office or email us at **sales@skyworksinc.com.**

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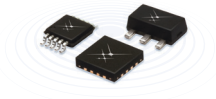

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