RF FAMILY OF PRODUCTS

Core innovations for differentiated RF systems

renesas.com/rf

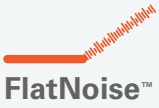
RF INNOVATIONS FOR TACKLING COMMON DESIGN CHALLENGES

Renesas is a leader in developing circuit-level RF innovations and is a trusted supplier to the leading communications systems providers. We use the Smart Silicon™ approach to leverage the best technologies to create a portfolio of differentiated RF products.

- Circuit–level innovations – Improved system-level performance and repeatability with lower power consumption and increased reliability
- Innovation through Smart Silicon™ – Unique product solutions using optimal process technology to achieve the best performance from SOI, GaAs, GaN, or SiGe
- Trusted partner – Technology supplier to world's leading communication system providers and deployed in global networks
- Established product portfolio – Broad portfolio with a proven history of reliability ranging from simple, single-function components to complex RF sub-systems

Glitch–Free™ Technology

Renesas' digital step attenuators (DSA) virtually eliminate transient overshoot that occurs during MSB attenuation state transitions of standard DSAs. With Glitch–Free technology, amplifier damage and loss of information at the ADC are avoided.



FlatNoise™ Technology

Renesas' variable gain amplifier (VGA) noise figure is kept virtually flat in the critical region, while gain is reduced. This greatly eases design constraints for radio engineers by enhancing signal–to–noise ratio (SNR).

Zero–Distortion™ Technology

Renesas' RF amplifiers and RF mixers improve SNR by reducing the noise floor and third order intermodulation distortion. This is important for crowded spectrum environments, as it enhances quality-of-service (QoS) and frees up under–utilized spectrum.

K_{LIN} Constant Linearity Technology

Renesas' variable gain amplifiers maintain constant high linearity as gain is adjusted. As the gain is reduced, the linearity (OIP3) remains constant in the critical region. This prevents intermodulation distortion from degrading as the gain is reduced.

$K_{|Z|}$ Constant Impedance Technology

Renesas' RF switches maintain nearly constant impedance when switching between RF ports. By controlling the impedance during the switching process voltage standing wave ratio (VSWR), transients are minimized. This improves switch reliability, reduces voltage stresses on downstream components, and improves overall system performance.

K_{GAIN} Constant Gain Compensation Technology

Renesas amplifiers are able to maintain near constant gain with KGAIN technology that automatically reduces S21 variation over temperature. Allowing temperature dependence to be controlled by design provides better tolerance and relative immunity to process variation which is particularly ideal for large signal chains.

RF Amplifiers

Amplifiers are key components for radio cards of various architectures. A versatile high-performance amplifier with low-power consumption will be critical to enabling the design of massive MIMO solutions for 5G wireless systems and other RF applications such as WiFi connectivity, radar and test and measurement.

Renesas offers RF amplifiers with a variety of gain, noise figure and linearity features, in either differential or single-ended input impedances. Our differentiated interface amplifiers feature built-in broadband baluns to support wide band applications with differential inputs and outputs. Some products feature innovative Zero-Distortion™ technology, enabling high output IP3 with very low current consumption – setting them apart from simple gain block amplifiers.

Driver Amplifiers

Part Number	Frequency (GHz)	Input	Output	Gain (dB)	NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Voltage (V)	Current (mA)	Package (mm)
F1420	0.7 – 1.1	50Ω SE	50Ω SE	17.4	4.5	23.2	42	5	105	4 x 4, 24–Pin
F1421	1.7 – 2.2	50Ω SE	50Ω SE	20.3	5.5	23	40	5	138	4 x 4, 24–Pin
F1475	0.7 – 2.8	50Ω SE	50Ω SE	18.5	4.8	30	42	5	225	4 x 4, 20–Pin
F1471	0.4 – 4.2	50Ω SE	50Ω SE	17	4.3	28.5	39	5	130	3 x 3, 16–Pin
F1490	1.8 – 5	50Ω SE	50Ω SE	39.5 / 35.5 [1]	2.5	24	38	5	75	3 x 3, 16–Pin
F1427	2.3 – 4.2	100Ω DIFF	50Ω SE	35	3.5	28	35	5	140	3 x 3, 16–Pin
F1485	2.3 – 5.0	50Ω SE	50Ω SE	36.5	3.8	27	32	5	110	3 x 3, 16–Pin

Interface Amplifiers

Part Number	Frequency (GHz)	Input	Output	Gain (dB)	NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Voltage (V)	Current (mA)	Package (mm)
F0424	0.6 – 5.0	50Ω SE	50Ω SE	17	2.3	21	40	3.3 / 5	70	2 x 2, 8–Pin
F1129LB	1.4 – 3.2	50Ω SE	100Ω DIFF	20	1.6	20.5	36	3.3 / 5	61	2 x 2, 12–Pin
F1129MB	3 – 4.2	50Ω SE	100Ω DIFF	19	1.8	18	32	3.3 / 5	60	2 x 2, 12–Pin
F1423	0.6 – 3.0	50Ω DIFF	50Ω SE	13.1	5.1	21.5	41.8	5	120	4 x 4, 24–Pin
F1429LB	1.4 – 3.2	100Ω DIFF	50Ω SE	21.5	1.9	22	40	3.3 / 5	64	2 x 2, 12–Pin
F1429MB	3.0 – 4.2	100Ω DIFF	50Ω SE	21	1.8	21	40	3.3 / 5	73	2 x 2, 12–Pin

Low Noise Amplifiers (LNA)

Part Number	Frequency (GHz)	Gain (dB)	NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Voltage (V)	Current (mA)	Package (mm)
F0109 [2]	0.65 – 1	18	0.55 [3]	24.5	41	5	120	4 x 4, 16–Pin
F0110 [2]	1.5 – 2.3	18.5	0.55 [3]	22	39	5	110	4 x 4, 16–Pin
F0111 [2]	2.2 – 4.2	18	0.7 [3]	23	38	5	90	4 x 4, 16–Pin

[1] Dual gain modes (high gain and low gain settings)
[2] Dual path amplifiers specified in a balanced configuration
[3] De-embedded to input pin of input hybrid coupler

Variable Gain Amplifiers

Renesas offers digitally controlled intermediate frequency (IF) and radio frequency (RF) variable gain amplifiers (VGA) with FlatNoise™ technology, an innovative technology where noise does not degrade as gain is reduced. These low-noise devices improve quality-of-service (QoS) and ease the signal-to-noise ratio (SNR) requirements of the downstream data converter to reduce system cost.

Some of Renesas' digital VGAs feature patented Glitch-Free™ technology, eliminating attenuation setting overshoot from the transmit and / or receive paths by reducing transient "glitches" by up to 95 percent during most significant bit (MSB) transitions. The Renesas RF VGAs are ideal for receiver and transmitter systems located in cellular base stations and other wireless infrastructure equipment.

Digital Variable Gain Amplifiers (DVGA)

Part Number	Frequency (GHz)	# Ch	Att. Range (dB)	Att. Step (dB)	Gain (dB)	NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Voltage (V)	Current (mA)	Package (mm)
F0440	0.6 – 2.7	2	6, 23, 18	6, 1, 6	11.6	4.7	20.2	40	5	123	6 x 6, 36–Pin
F0443	0.45 – 2.7	2	6, 6, 23, 18	6, 6, 1, 6	29.5	3.2	19.7	39	5	186	7 x 7, 48–Pin
F0448	3.3 – 4.2	2	6, 23, 18	6, 1, 6	13	5.9	18	37	5	110	6 x 6, 36–Pin
F0480	0.4 – 2.7	1	23	1	13	4	22.2	41	4.75 – 5.25	100	5 x 5, 32–Pin
F1106	1.4 – 3	2	31.5	0.5	32	7.3	20	39	3.3 / 5.0	195	6 x 6, 36–Pin
F1107	3 – 4	2	31.5	0.5	30.5	8.7	21	38	3.3 / 5.0	205	6 x 6, 36–Pin
F1200	0.05 – 0.16	1	23	0.25	21.7	2.6	19.4	48	5	110	5 x 5, 28–Pin
F1240	0.01 – 0.5	2	31.5	0.5	20	4	19.7	47	5	80	5 x 5, 32–Pin
F1431B	0.35 – 3	1	23	0.5	14.3	4.2	23.3	41.1	5	150	4 x 4, 24–Pin
F1440	0.5 – 1	1	31.5	0.5	42.5	3.2	30	41.5	5	305	5 x 5, 32–Pin
F1441	1.35 – 2.8	1	31.5	0.5	40	2.5	27	41	5	350	5 x 5, 32–Pin
F1451	0.45 – 1.1	1	29.5	0.5	32	3.6	23	41	5	185	6 x 6, 28–Pin
F1455	1.4 – 2.3	1	29.5	0.5	32.8	3.9	23	38.5	5	220	6 x 6, 28–Pin
F1456	2.1 – 2.95	1	31.5	0.5	32.1	3.9	21.5	38	5	215	6 x 6, 28–Pin
F4481	0.4 – 1.1	4	31.5	0.5	28	5.7	17	35	3.3	131	8 x 8, 56–Pin
F4482	1.3 – 2.8	4	31.5	0.5	27.5	5.7	16.7	36.8	3.3	121	8 x 8, 56–Pin

Variable Gain Amplifiers (VGA)

Part Number	Frequency (GHz)	Max Att. (dB)	Gain (dB)	NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Voltage (V)	Current (mA)	Package (mm)
F2480	0.4 – 3	35.5	14.1	4.5	19.7	41	36	106	5 x 5, 32–Pin

Dual Variable Voltage Attenuator + Variable Gain Amplifier (VVA+VGA)

Part Number	Frequency (MHz)	Mode	Att. Range (dB)	Gain (dB)	NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Voltage (V)	Current (mA)	Package (mm)
F1280	0.001 – 1200	VVA1+VGA1	24	18.5[1]	5.4[1]	12[1]	28[1]	5	145	5 x 5, 32–Pin
		SW+VVA2+VGA2	24	18.5[1]	5.6[1]	14.5[1]	35[1]			

[1] Gain Code 11, V_{GAIN} = 1.1V

Dual-Channel Switch + Low Noise Amplifier Modules Rx FEM

Part Number	Frequency (GHz)	TX Mode Power Handling (dBm)	High / Low Gain Mode (dB)	NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Voltage (V)	Current Per Channel (mA)	Package (mm)
F0452C	2.3 – 2.7	30 + 7.5dB PAR	34 / 28	1.6	15	23	3.3	65	6 x 6, 32–Pin
F0453C	3.3 – 4.0	30 + 7.5dB PAR	35 / 29	1.35	15	23	3.3	65	6 x 6, 32–Pin
F0472B	2.3 – 2.7	34 + 9dB PAR	34 / 28	1.2	15	23	3.3	65	5 x 5, 32–Pin
F0452B	2.3 – 2.7	30 + 7.5dB PAR	34 / 28	1.5	15	23	3.3	65	5 x 5, 32–Pin
F0453B	3.3 – 4.0	30 + 7.5dB PAR	34.5 / 28.5	1.35	15	23	3.3	65	5 x 5, 32–Pin

RF Attenuators

Renesas offers a wide range of monolithic silicon RF Attenuators that utilize either digital or analog control. All of Renesas' RF attenuators offer broad bandwidth, low insertion loss, low error, and high linearity with high attenuation accuracy. Patented Glitch-Free™ technology eliminates attenuation setting overshoot from the transmit and / or receive paths by reducing transient glitches during most significant bit (MSB) transitions by up to 95 percent. This enables customers to simplify their software interface, improve reliability, and limit over-ranging of data converter inputs while preventing damage to expensive sub-assemblies such as power amplifiers, and limit over-ranging of data converter inputs.

Digital Step Attenuators (DSA)

Part Number	Description	Frequency (GHz)	Max Att. (dB)	Resolution (dB)	IL (dB)	IP0.1dB (dBm)	IIP3 (dBm)	Voltage (V)	Current (mA)	Package (mm)
F1912	6–bit	0.001 – 5	31.5	0.5	1.4	31	60	3.3	0.55	4 x 4, 20–Pin
F1950	7–bit	0.15 – 4	31.75	0.25	1.3	27.5	63	3.3	0.25	4 x 4, 24–Pin
F1951	6–bit	0.1 – 5	31.5	0.5	1.2	29	64	3.3	1.1	4 x 4, 24–Pin
F1953	6–bit	0.4 – 4	31.5	0.5	1.4	28.5	66	3	0.2	4 x 4, 20–Pin
F1956	7–bit	0.001 – 6	31.75	0.25	1.6	34.5	64	3.3	0.35	5 x 5, 32–Pin
F1958	7–bit	0.001 – 6	31.75	0.25	1.6	35	64	3.3	0.25	4 x 4, 24–Pin
F1975	6–bit, 75Ω	0.005 – 3	31.5	0.5	1.2	30.5	64	3.3	0.55	4 x 4, 20–Pin
F1977	7–bit, 75Ω	0.005 – 3	31.75	0.25	1.4	32	64	3.3	0.322	5 x 5, 32–Pin
F1978	6–bit, 75Ω	0.005 – 3	31.5	0.5	1.2	30.5	64	3.3	0.55	4 x 4, 20–Pin

Variable Voltage Attenuators (VVA)

Part Number	Description	Frequency (GHz)	Max Att. (dB)	IL (dB)	IP1dB (dBm)	IIP3 (dBm)	Voltage (V)	Current (mA)	Package (mm)
F2250	Positive or Negative Slope Control	0.05 – 6	35	1.4	34.4	65	3.3	1.17	3 x 3, 16–Pin
F2251	Positive Slope Control	0.05 – 6	35	1.4	34.4	67	3.3	0.8	3 x 3, 16–Pin
F2255	Positive or Negative Slope Control	0.001 – 3	34.6	1.1	36	60	3.3	1.15	3 x 3, 16–Pin
F2258	Negative Slope Control	0.05 – 6	35	1.4	34.4	65	3.3	1.17	3 x 3, 16–Pin
F2270	Positive or Negative Slope Control	0.005 – 3	35	1.1	36	60	3.3	1.4	3 x 3, 16–Pin

Integrated TRx ICS

Renesas' integrated TRx ICs leverage several key technology innovations, such as Zero-Distortion™ mixers in combination with interstage filtering and proprietary DVGAs. The synergy of these technologies greatly benefit 2G/3G/4G MIMO and multi-carrier basestation receivers. The F159V completes the new lineup as this dual path RF Transmitter IC includes a quadrature modulator, voltage variable attenuator, digital step attenuator and fixed gain amplifier on each signal path.

Part Number	Description	Frequency (GHz)	Gain (dB)	OP1db(dBm)	OIP3 (dBm)	Voltage (V)	Current (mA)	Package (mm)
F0502	Dual Path Rx IC	0.6 – 1.0	28.2	20.2	44	4.75 – 5.25	480	10 x 10, 68–QFN
F0552	Dual Path Rx IC	1.7 – 2.0	28	19.5	46	4.75 – 5.25	455	10 x 10, 68–QFN
F0562	Dual Path Rx IC	2.3 – 2.7	29	19.8	44	4.75 – 5.25	390	10 x 10, 68–QFN
F159V	Dual Path Tx IC	0.45 – 2.8	18.3	14	31	3.3	685	10 x 10, 68–QFN

RF Switches

The ever-increasing demand for more data at higher throughput continues to drive the evolution of systems standards and require RF components with much higher performance that will improve a system's SNR to increase data rates and throughput. Renesas continues to expand its RF switches portfolio with industry leading performance to address these evolving needs. Many switches feature very low insertion loss, high input IP3 performance, and Kz constant impedance technology. High-isolation switches feature wide frequency bandwidth and an extended operating temperature range designed for high-reliability applications.

Part Number	Description	Frequency (GHz)	Type	IL (dB)	IP0.1dB (dBm)	IP1dB (dBm)	IIP3 (dBm)	Voltage (V)	Current (mA)	Package (mm)
F2910	SPST	0.03 – 8	Absorptive	0.55	34	35	67	3.3/5	0.19	2 x 2, 8–Pin
F2911	SPST 75Ω	0.001 – 3.5	Absorptive	0.33	33	34	64	3.3/5	0.19	2 x 2, 8–Pin
F2912	SPDT	0.000009 – 9	Absorptive	0.4	–	30	66	3.3	0.02	4 x 4, 20–Pin
F2913	SPDT	0.05 – 6	Absorptive	0.79	–	36	65	3.3	0.09	4 x 4, 20–Pin
F2914	SP4T	0.05 – 8	Absorptive	1.1	35	–	60	3.3	0.29	4 x 4, 24–Pin
F2915	SP5T	0.05 – 8	Absorptive	1.1	35	36.5	60.5	3.3	0.29	4 x 4, 24–Pin
F2923	SPDT	0.0003 – 8	Absorptive	0.48	–	32	66	3.3	0.127	4 x 4, 20–Pin
F2932	SPDT	0.05 – 8	Absorptive	0.79	32.3	36.5	64	5	0.26	4 x 4, 16–Pin
F2933	SPDT	0.05 – 8	Absorptive	0.79	32.3	36.5	64	5	0.26	4 x 4, 16–Pin
F2934	SPDT	0.05 – 8	Absorptive	0.79	32.3	36.5	64	5	0.26	3 x 3, 16–Pin
F2950	SPDT	0.1 – 8	Reflective	0.58	–	40	69	3.3/5	0.17	1.5 x 1.5, 6-Pin
F2970	SPDT 75Ω	0.005 – 3	Absorptive	0.32	–	32	63	3	0.02	4 x 4, 20–Pin
F2971	SPDT 75Ω	0.005 –3	Absorptive	0.31	–	32	67	3	0.02	4 x 4, 20–Pin
F2972	SPDT	0.005 – 10	Reflective	0.4	40	–	77	3.3	0.08	2 x 2, 12–Pin
F2976	SPDT	0.005 – 10	Reflective	0.4	40	–	77	3.3	0.08	2 x 2, 12–Pin
F2977	SPDT	0.03 – 6	Reflective	0.38	40	–	77	3.3	0.08	2 x 2, 12–Pin

RF Mixers

Renesas' RF mixers feature patented Zero-Distortion™ technology which dramatically improves the maximum signal levels (IM3 tones) that a receiver can withstand at a desired SNR. These devices are scalable, so one can run the devices in modes that significantly reduce power consumption while still maintaining high linearity. The active mixers have excellent out-of-band spur performance which eases pre-filtering requirements. RF and LO baluns are internal allowing for simple 50Ω interfaces. The IF ports are configured as differential 200Ω to drive pre-ADC filters with low even-order distortion.

Part Number	Description	RF Freq. (GHz)	LO Freq. (GHz)	IF Freq. (GHz)	Gain (dB)	IP1dB (dBm)	OIP3 (dBm)	Voltage (V)	Current (mA)	Package (mm)
F1100	RF to IF Dual	0.698 – 0.915	0.848 – 1.365	0.15 – 0.45	9	13.1	41	5	350	6 x 6, 36–Pin
F1102	RF to IF Dual	0.4 – 1	0.5 – 1.15	0.05 – 0.3	9.2	12.5	43	5	330	6 x 6, 36–Pin
F1130	RF to IF Dual	0.4 – 1.1	0.5 – 1.13	0.03 – 0.40	9.0	9.0	43	5	360	7 x 7, 48–Pin
F1150	RF to IF Dual	1.7 – 2.2	1.8 – 2. 65	0.05 – 0.45	8.5	13	40	5	335	6 x 6, 36–Pin
F1152	RF to IF Dual	1.4 – 2.2	1.35 – 2.1	0.05 – 0.35	8.5	13.2	43	5	327	6 x 6, 36–Pin
F1162	RF to IF Dual	2.3 – 2.7	1.8 – 2.9	0.05 – 0.5	8.9	13	43	5	330	6 x 6, 36–Pin
F1178	RF to IF Dual	3.4 – 3.8	2.9 – 3.62	0.05 – 0.5	9	11	37.5	5	297	6 x 6, 36–Pin
F1180	RF to IF Dual	1.4 – 2.7	1.35 – 2.90	0.03 – 0.55	8.2	9	38	5	365	7 x 7, 48–Pin
F1192B	Dual Wideband Gain–Settable	0.4 – 3.8	0.4 – 3.6	0.05 – 0.6	11.1	7	35	3.3	240	4 x 4, 24–Pin
F1701	RF to IF Single	0.6 – 1.06	0.63 – 1.26	0.07 – 0.3	11.8	10.2	43	5	184	5 x 5, 20–Pin
F1751	RF to IF Single	1.4 – 2.5	1.4 – 2.5	0.05 – 0.5	11.8	9.7	43	5	190	5 x 5, 20–Pin
F1763	RF to IF Single	2 – 2.9	1.8 – 3	0.05 – 0.5	11.7	10.2	42	5	200	5 x 5, 20–Pin
F1792	Single Wideband Gain–Settable	0.4 – 3.8	0.4 – 3.6	0.05 – 0.6	11.1	7	35	3.3	134	4 x 4, 24–Pin

Modulators / Demodulators

Renesas' Zero-Distortion™ and Glitch-Free™ pin-compatible IQ demodulators offer excellent IM3 performance and ultra-low-power consumption while at the same time resulting in less than 0.5dB overshoot ringing during MSB gain transitions. Similarly, Renesas' Zero-Distortion IQ modulators provide very high IP3 and IP2 performance resulting in superb ACLR performance compared to other devices.

Demodulators

Part Number	Description	RF Freq. (GHz)	LO Freq. (GHz)	IF Freq. (GHz)	Gain (dB)	Max Att. (dB)	OIP3 (dBm)	Voltage (V)	Current (mA)	Package (mm)
F1320	DPD for PA Linearization	0.55 – 1.15	0.5 – 1.3	0.02 – 0.035	12.5	25.5	43	5	262	6 x 6, 36–Pin
F1350	DPD for PA Linearization	1.30 – 2.90	1.40 – 2.90	0.02 – 0.500	12.5	25.5	41	5	275	6 x 6, 36–Pin
F1358	DPD for PA Linearization	3.2 – 4	3.1 – 3.8	0.02 – 0.5	10.2	25.5	41	5	216	6 x 6, 36–Pin
F1385	DPD for PA Linearization	3.2 – 4.4	2.85 – 4.05	0.02 – 0.5	18	25.5	39	5	210	6 x 6, 36–Pin
F1375	DPD for PA Linearization	1.3 – 2.9	1.3 – 2.9	0.02 – 0.5	9	25.5	40	5	270	6 x 6, 36–Pin

Modulators

Part Number	Description	RF Freq. (GHz)	LO Freq. (GHz)	BB Freq. (GHz)	Gain (dB)	OP1dB (dBm)	OIP3 (dBm)	Voltage (V)	Current (mA)	Package (mm)
F1653	ZIF / CIF	0.6 – 2.9	0.6 – 2.9	0 – 0.6	3	15	36	3.3	178	4 x 4, 24–Pin

RF PLLs and Synchronizers

Radio synchronizers and JESD204B/C clock jitter attenuators offer industry-leading phase noise for best 4G/5G radio EVM performance, excellent close-in phase noise for enhanced Common Public Radio Interface (eCPRI) and CPRI applications, and high fanout for high-density radios. Single-chip radio synchronization devices integrate digital PLLs (DPLLs) with a high-performance RF PLL and support PTP (Precision Timing Protocol, IEEE 1588), synchronous Ethernet, 1PPS input and output signals, and a tight phase alignment. These devices remove virtually all noise from an input reference clock, making them suitable for the data converter reference clock generation and synchronization.

Part Number	Product Title	Application	Input Freq Range (GHz)	Output Freq Range (GHz)	Phase Jitter RMS (ps)	Noise Floor (dBc/Hz)	Synthesis Mode	Package
8V97003	Wideband 18 GHz RF and microwave synthesizer	5G Wireless Radio Unit (RU)	up to 1.6	up to 18	0.05	-165	Fractional, Integer	7x7, QFN-48
8V19N880 / 82	Low power and low-noise radio unit jitter attenuator	5G Wireless Radio Unit (RU)	up to 2	up to 6	0.08	-165	Integer	11x11, BGA-100 10x10, QFN-76
8V19N850	Ultra-low noise radio unit clock synchronizer and jitter attenuator	5G Wireless Distributed Unit (DU), Radio Unit (RU)	up to 1	up to 1	0.1	-165	Fractional, Integer	10x10, QFN-88
RC38612	Radio access network equipment synchronizer	5G wireless baseband, DU, CU, RU, fronthaul or backhaul networks	up to 1	up to 1	0.15	-158	Fractional	10x10 QFN-72

Beamforming ICs and Up/Down Converter for 5G mmWave

Renesas' phased array beamforming ICs enable cost-effective, next generation system solutions for 5G mmWave, Satcom, and radar applications. Each beamforming IC contains multiple independently controlled active channels for element-level beam pattern shaping in electronically scanned array antennas (ESAs). The compact ICs are available in chip-scale BGA packages to enable very low profile and small form factor phased array antennas with λ / 2 element spacing. The ICs are available as transmit-only (Tx), receive-only (Rx), or transmit / receive (TRx) variants covering 5G mmWave, Satcom and radar frequency bands. Renesas' beamformer product line is rapidly expanding to address growing commercial demand for affordable phased array antennas.

TRx Active Beamforming ICs for 5G mmWave

Part Number	Description	Frequency (GHz)	Tx Gain (dB)	Tx OP1dB (dBm)	Tx Linear Power (dBm)	Rx Electronic Gain (dB)	RX NF (dB)	Voltage (V)	Package (mm)
F5268	8T8R DP 26 GHz	24.25 – 27.5	31	19.4	13[2]	19.2[1]	4.8	2.4 - 2.6	5.1 x 5.1, 118-BGA
F5288	8T8R DP 28 GHz	26.5 – 29.5	29.4	19.2	14.5[2]	16.4[1]	4.9	2.4 - 2.6	5.1 x 5.1, 118-BGA
F5280	4T4R SP 28 GHz	25 – 31	29	13	5	19	6.3	2.3 - 2.7	3.6 x 3.6, 49-BGA

[1] Single path gain (SPG) is the S21 measured between RFn and RFC ports. For electronic gain (EG), 6dB division loss should be added to SPG (EG = SPG + 6dB)

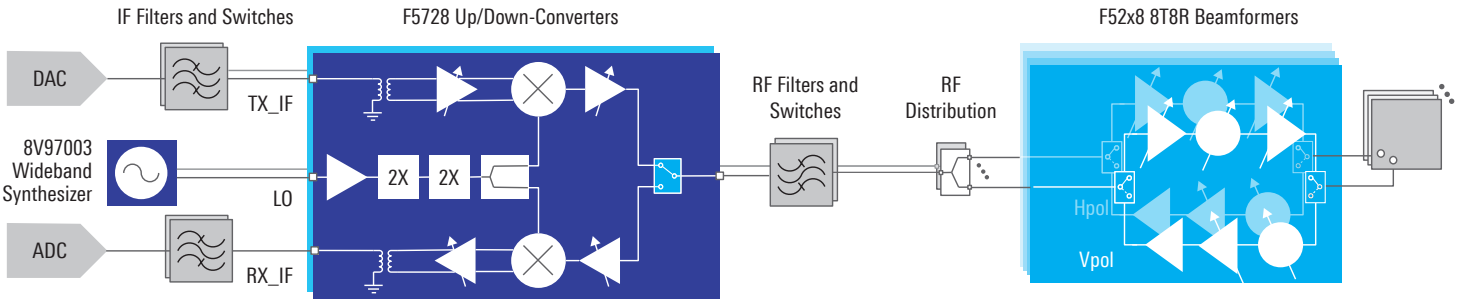
[2] Output power level at 3% EVM for 400 MHz 5G-NR waveform

Up / Downconverters for 5G mmWave[1]

Part Number	Description	RF Freq. (GHz)	IF Freq. (GHz)	RX Gain (dB)	RX NF (dB)	TX Gain (dB)	OP1dB (dBm)	Voltage (V)	Package (mm)
F5728L8	1T1R Up/Down Converter	26.5 – 29.5	2 – 5	21	6	31.9	16.2	2.3 – 2.7	4 x 4, 49-BGA
F5728H8	1T1R Up/Down Converter	26.5 – 29.5	3.5 – 7	24	5.4	33	16.5	2.3 – 2.7	4 x 4, 49-BGA
F5728L6	1T1R Up/Down Converter	24.25 – 27.5	2 – 5	22.8	5.8	32.6	17	2.3 – 2.7	4 x 4, 49-BGA
F5728H6	1T1R Up/Down Converter	24.25 – 27.5	3.5 – 7	24	5.5	33.5	16.8	2.3 – 2.7	4 x 4, 49-BGA

[1] Various orderable part numbers deliver specific parameters

Typical Implementation Example of 5G mmWave Active Antenna System



Beamforming ICs and Low Noise Amplifiers for Satcom/Radar

Renesas offers industry-leading beamforming ICs (BFICs) and low noise amplifiers (LNAs) for Satcom and radar applications, enabling the realization of cost-effective, efficient, reliable, and low-profile phased array antenna solutions. The ICs are designed for use in next-generation airborne, maritime and ground-based systems operating in X,Ku,K and Ka bands. The combination of separate Tx and Rx BFICs and standalone LNAs provides flexibility to support a wide variety of popular antenna architectures while producing the highest efficiency and G/T performance.

Rx Dual-Beam[1] Active Beamforming ICs for Satcom / Radar

Part Number	Description	Frequency (GHz)	Electronic Gain (dB)	NF (dB)	Voltage (V)	Package (mm)
F6121	16-channel Ku–Band	10.7 – 12.75	10.7	6.1	2.1 – 2.5	3.8 x 4.6, 63-BGA
F6122	16-channel Ka–Band	17.7 – 21.2	8.3	5.4	2.1 – 2.5	3.8 x 4.6, 63-BGA
F6123	16-channel Ku / CDL–Band	14 – 17	10.2	5,5	2.1 – 2.5	3.8 x 4.6, 63-BGA
F6212	16-channel Ka–Band[2]	17.7 – 21.2	27	2	2.1 – 2.5, 0.9 – 1.0	7.6 x 7.6, 165-BGA

[1] All dual-beam ICs are programmable for single-beam mode operation resulting in a 30-40% reduction in power consumption. The F6212 is also available as a lower cost single-beam variant under P/N F6202.

[2] F6212 is a multichip package (MCP) that contains F6122 BFIC and F6922 LNA

Tx Active Beamforming ICs for Satcom / Radar

Part Number	Description	Frequency (GHz)	Gain (dB)	OP1dB (dBm)	Voltage (V)	Package (mm)
F6521	8–ch Ku–Band	13.75 – 14.5	25	10.5	2.1 – 2.5	3.8 x 4.6, 62-BGA
F6522	8–ch Ka–Band	27.5 – 31.0	28	11	2.1 – 2.5	3.8 x 4.6, 62-BGA
F6513	8–ch Ku / CDL–Band	14 – 17	23	12.5	2.1 – 2.5	3.8 x 4.6, 62-BGA
F6506	8-channel K-Band	19.7 – 22.7	30	16	2.4 – 2.6	5.1 x 5.1, 118-BGA

Low Noise Amplifiers for Satcom / Radar

Part Number	Description	Frequency (GHz)	Gain (dB)	NF (dB)	OP1dB (dBm)	OIP3 (dBm)	Voltage (V)	Current (mA/ch)	Package (mm)
F6921	Dual–ch LNA, Ku–Band Satcom	10.7 – 12.75	19.5	1.4	–7	2	0.9 – 1.0	13	2.7 x 2.7, 23-BGA
F6922	Dual–ch LNA, Ka–Band Satcom	17.7 – 21.2	19.5	1.8	–2	10	0.9 – 1.0	16	2.7 x 2.7, 23-BGA
F6923	Dual–ch LNA, Ku / CDL–Band	14 – 17	19.5	1.5	–2	10	0.9 – 1.0	17	2.7 x 2.7, 23-BGA
F6931	Dual-ch LNA, Ku–Band Satcom	10.7 – 12.75	24	1.2	–1	7	1.1 – 1.3	9.5	2.7 x 2.7, 23-BGA
F6932	Dual-ch LNA, Ka–Band Satcom	17.7 – 21.2	22	1.2	–2	7	1.1 – 1.3	12.4	2.7 x 2.7, 23-BGA

Visit **renesas.com/rf** for more details on the complete portfolio of RF products, including datasheets, eval boards and samples.

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