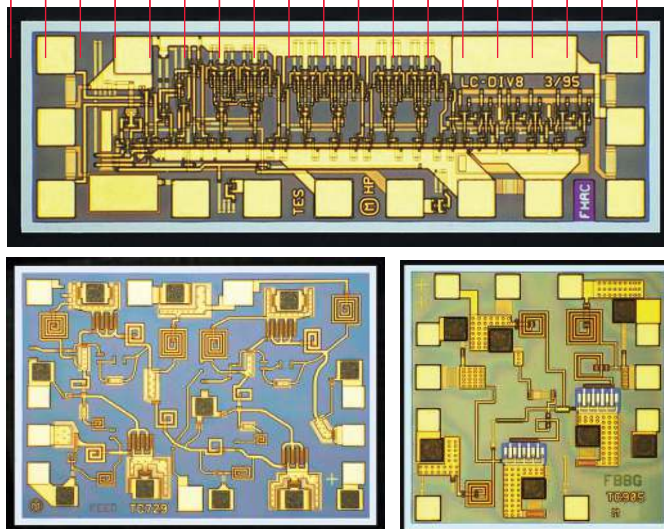


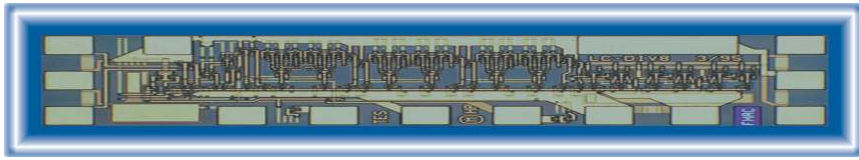
# Keysight Technologies

## High Frequency Technology Center IC Selection Guide

Selection Guide



## Keysight MMICs



### Overview

Keysight Technologies, Inc. MMICs are designed and fabricated in Santa Rosa, California in our High Frequency Technology Center (HFTC). HFTC is a supplier of high performance semiconductor based solutions to customers in instrumentation, communications, and defense electronics markets. Driven by performance, quality, and reliability requirements of Agilent Technologies test instrumentation, HFTC has developed a leadership position in supplying high frequency IC “building blocks,” as well as custom semiconductor solutions from RF to mm-wave frequencies. HFTC’s research and manufacturing investments are managed to deliver superior value to customers through:

- Performance
- Reliability
- Fast time to market
- Assured supply
- High level product support

### Technology

HFTC has been shipping Compound Semiconductor (III-V) based ICs in test equipment applications since 1985. At the present time, there are eight III-V IC, and two GaAs integrated diode processes in manufacturing. Over 300 different ICs have been designed in these processes and are shipping at a rate of over 100,000 ICs per month. Over 16 million GaAs ICs have been shipped from these processes to customers in a wide variety of markets. Our current products include:

- Amplifiers
- Synthesis ICs
- Digital ICs
- ICs diodes
- I/Q modulators
- Mixers
- Multipliers
- Prescalers
- Switches/attenuators

### Current processes

- 350 nm MESFET—24 GHz Ft
- 250 nm pHEMT—60 GHz Ft
- 110 nm pHEMT—95 GHz Ft
- 2x2  $\mu\text{m}$  InGaP HBT—70 GHz, 16 V BVcbo
- 2x2  $\mu\text{m}$  Power HBT—45 GHz, 26 V BVcbo
- 1x3  $\mu\text{m}$  InP DHBT—185 GHz, 7 V BVcbo
- Hyper-abrupt diode
- Modified barrier diode

## Keysight MMICs *continued*

### Reliability

Reliability is designed into all HFTC processes and products in keeping with Keysight's long standing instrument tradition. To assure this reliability we use a two-phase process. Phase 1 consists of quantitatively determining the lifetime, or failure rate of the circuit at its maximum rated use conditions. The failure rate of a circuit is generally determined by the following tests:

- Thermal resistance measurement
- Step stress test (to failure)
- High temperature operating life

Phase 2 of the reliability program assesses the environmental ruggedness of the circuit. This phase determines the circuit's:

- Sensitivity to humidity
- ESD damage thresholds
- RF power handling (damage level)

## Modeling Simulation and Characterization

### Overview

HFTC has capitalized on our unique intersection of expertise in semiconductors, measurements, software, and modeling science to create world-class models and tools. This enables the creation of differentiating IC and module designs to economically push the envelope in product design, cost, and performance.

Keysight Technologies' X-parameters\* are a new category of nonlinear network parameters for high-frequency design, and were developed and introduced by Keysight in 2008 as functionality included in the nonlinear vector network analyzer (NVNA), and the Advanced Design System. X-parameters are applicable to both large-signal and small-signal conditions, and for linear and nonlinear components. X-parameters characterize the amplitudes and relative phase of harmonics generated by components under large input power levels at all ports. They correctly characterize impedance mismatches and frequency mixing behaviors to allow accurate simulation of cascaded nonlinear X-parameter blocks, such as amplifiers and mixers in wireless design.

Keysight will be releasing X-parameter files for select Keysight MMICs. For more information, please contact the MMIC helpline at: [mmic\\_helpline@keysight.com](mailto:mmic_helpline@keysight.com).

\* X-parameters is a trademark and registered trademark of Agilent Technologies in the US, EU, JP, and elsewhere. The X-parameters format and underlying equations are open and documented. For more information, visit <http://www.agilent.com/find/eesof-x-parameters-info>.

## Available MMICs

The products on the following pages are devices currently available for use and sale external to Keysight Technologies.

Restricted sale: Devices in the data tables restricted for sale only to select customers are *shaded in gray*.

### Amplifier ICs

Type	TC number	Part number	Description	Freq GHz	Gain dB	NF dB	P1dB	Iso dB	V
Linear	TC200	HMMC 5200	Feedback amplifier	DC-20	9.5	8.5	8	15	4.75
	TC700	HMMC 5021	TWA amplifier	2-22	10	8	18	32	
	TC700	HMMC 5022	TWA amplifier	2-22	10	8	18	32	
	TC700	HMMC 5026	TWA amplifier	2-26.5	9.5	10	15	30	7
	TC729	HMMC 5620	Feedback amplifier	6-20	17	9	12	55	5/7
	TC900	HMMC 5025	TWA amplifier	2-50	8.5	7	12	30	5
LNA	TC904B	HMMC-5023	23 GHz LNA	20 - 26	24	2.5	10	50	5
	TC911	HMMC-5038	38 GHz LNA	37-40	21	4.8	12	50	3
Driver	TC702	HMMC-5027	TWA amplifier	2-26.5	7	11	19	29	8
	TC905	HMMC-5618	6-20 GHz feedback amplifier	6-20	14	5.5	18	40	5
	TC906	HMMC-5040	20-40 GHz amplifier	20-40	22		18	54	4.5
	TC916	HMMC-5032	17.7-32 GHz driver amplifier	17.7-32	8		22	30	4.5
	TC926	HMMC-5034	Driver amplifier +23 dBm	37-42.5	7		22	27	4.5
	TC956	1GG6-8070	30-70 Med pwr amp	30 - 70	18	10	14	40	3
Power	TC915	HMMC-5033	Power amplifier +26 dBm	17.7-32	22		26	50	5
	TC724	1GG7-8045	TWA amplifier	2-26.5	7.5	11	23	27	11

\*The HMMC-5021 and HMMC-5022 have the same typical specifications, but the HMMC-5022 has higher performing minimums.

## Available MMICs *continued*

### Attenuator ICs

TC number	Part number	Description	Freq GHz	GAIN Db	P1dB dBm	TOI dBm	Range dB	V
TC709	HMMC 1015	Variable attenuator-low distort	DC-50	-1 to -3.9	27		30	10
TC721	HMMC 1002	Variable attenuator	DC-50	-1 to -3.9			30 to 35	

### Diodes

TC number	Part number	Description	Freq GHz	GAIN Db	P1dB dBm	TOI dBm	Range dB	V
TC231	1GC1-8053	Dual 50 Gb/s ESD, output limiting IC	DC-65	-2			0.5-2 Vp-p	32
TC231P	1GC1-8235	Dual 50 Gb/s ESD, output limiting QFN	DC-65	-2			0.5-2 Vp-p	32
TC611	HSCH-9161	GaAs detector diode, beam lead	DC-100					
TC611	HSCH-9162	GaAs detector diode, beam lead	DC-100					
TC626P	1GG5-8205	GaAs integrated limiter, QFN	DC-26.5	-0.2 to -0.6				

### IQ Modulators

TC number	Part number	Description	Freq GHz	GAIN Db	Pin dBm	P1db dBm	TOI dBm	V
TC932	1GG6-8083	8 GHz I/Q modulator	0.25-8		8		27	6

### Mixer

TC number	Part number	Description	Freq GHz	GAIN Db	NF dB	P1dB dBm	TOI	V
TC230P	1GC1-8234	Active mixer, QFN package	DC-20					
TC260	1GC1-8068	50 GHz active mixer	DC-50	-8		0		-6
TC676	1GG5-8045	110 GHz harmonic mixer	0-110	-34				

Available MMICs *continued*

## Prescalers

TC number	Part number	Description	Freq		P1dB		
			GHz	Pin	/Pout	V	mA
TC202	HMMC-3004	÷ 4	DC-16	-25 to +10/-10 to +5	0/6	5	60/89
TC202P	HMMC-3104	÷ 4 pkg, SSOP-8 lead	DC-16	-25 to +10/-10 to +5	6	5	80
TC203	HMMC-3008	÷ 8	DC-16	-25 to +10/-10 to +5	0/6	5	66/86
TC203P	HMMC-3108	÷ 8 pkg, SSOP-8 lead	DC-16	-25 to +10/-10 to +5	6	5	86
TC204	HMMC-3002	÷ 2		-25 to +10/-10 to +5	0/6	5	68/80
TC204P	HMMC-3102	÷ 2 pkg, SSOP-8 lead		-25 to +10/-10 to +5	6	5	80
TC207B	HMMC-3024	÷ 4		-25 to +10/-10 to +5	-6/ 0	5	30/40
TC207P	HMMC-3124	÷ 4 pkg, SSOP-8 lead		-25 to +10/-10 to +5	0	5	40
TC208	HMMC-3028	÷ 8		-25 to +10/-10 to +5	-6/0	5	34/44
TC208P	HMMC-3128	÷ 8 pkg, SSOP-8 lead		-25 to +10/-10 to +5	0	5	44
TC209B	HMMC-3022	÷ 2		-25 to +10/-10 to +5	-6/0	5	30/40
TC209P	HMMC-3122	÷ 2 pkg, SSOP-8 lead		-25 to +10/-10 to +5	0	5	40

## Switches

TC number	Part number	Description	Type	Freq GHz	Gain dB	P1 dB		Iso dB	V
						dBm	TOI		
TC728	HMMC-2027	26 GHz SPDT	Terminated	DC-26.5	-2.5	27		30	10
TC732	HMMC-2007	8 GHz SPDT	Terminated	DC-8	-1.1	27		35	10
TC950	1GG5-8045	5 GHz SPDT	Reflective	DC-50 (75)	-2.6	17	31	29	±3

## Application and Product Notes

Reference number	Title
AN31	<i>A 2-26.5 GHz TC702 Var. Gain Amplifier</i>
AN34	<i>TWA Environmental Data</i>
AN35	<i>TC727 Switch Driver with TTL Input</i>
AN37	<i>TC721 Attenuator Attenuation Control</i>
AN41	<i>S-Parameters as a Function of Bonding</i>
AN42	<i>MMICB Reliability</i>
AN44	<i>TC721 Attenuator S-Parameters</i>
AN45	<i>TC721 Attenuator Switching Speed Limits</i>
AN46	<i>TC906 Reliability</i>
AN49	<i>TC905 Power, Harmonics, and IMD</i>
AN50	<i>TC906 as a 2040 GHz Multiplier</i>
AN51	<i>PH9 Reliability</i>
AN52	<i>1 Watt 17.7-32 GHz Linear Power Amp</i>
AN53	<i>HB2A Reliability</i>
AN54	<i>GaAs MMIC ESD, Die Attach &amp; Bonding</i>
AN55	<i>Beam Lead Diode Bonding &amp; Handling</i>
AN56	<i>GaAs MMIC Users Guide</i>
TC721	<i>HMMC-1002</i>
AN57	<i>TC727 Switch Speed &amp; Settling Times</i>
PN01	<i>TC421 Diode Model</i>
PN02	<i>TC611 Diode Model</i>
PN04	<i>TC916 Intermodulation Distortion</i>
PN05	<i>TC915 Driven by a TC905</i>
PN06	<i>TC915 Intermodulation Distortion</i>
PN07	<i>32 GHz Noise Figure Measurements</i>
PN08	<i>1 Watt 37-43 GHz Linear Power Amp</i>
PN10	<i>TC721 50 GHz Attenuator Performance</i>
PN11	<i>TC904B as a Doubler to 24 and 28 GHz</i>
PN12	<i>TC611 Detector Sensitivity Measurements</i>
PN13	<i>TC904B as a 24 &amp; 29 GHz Gain Control</i>
PN14	<i>TC905 Driven by a TC200</i>
PN15	<i>TC913 Multiplier Operation</i>
PN16	<i>TC421 Detector Sensitivity Measurements</i>
PN17	<i>TC743 Conversion Loss Measurements</i>

## Service and Support

### Data sheets

Complete data sheets for the devices listed in this Selection Guide can be found at the Website: [www.keysight.com/find/mmic](http://www.keysight.com/find/mmic)

### Support

Technical support for the HFTC GaAs devices is provided through the local distributors. If you have any questions about current or future devices, please contact the MMIC helpline at: [mmic\\_helpline@keysight.com](mailto:mmic_helpline@keysight.com)

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