Qorvo® Broadband Access, CATV & FTTH Product Selection Guide

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all around you

Technology Leadership in Broadband Connections Through Best-in-Class Innovative RF Solutions

Qorvo offers leading technology and comprehensive product solutions for demanding hybrid fiber coaxial (HFC) and broadband applications. Qorvo's broadband portfolio includes high power amplifiers in industry-standard SOT115J package and in multi-chip modules (MCMs), low power MMICs and control products. These products are designed for HFC headend, CMTS, optical nodes and distributed architecture supporting DOCSIS® standards in various configurations like fiber deep, node split, remote PHY, and full duplex. In addition, Qorvo offers products for FTTx and xPON system solutions with transimpedance amplifiers and complete optical modules.

High Output Hybrid & MCMs

1.218 GHz DOCSIS 3.1 Power Doubler Amplifiers

Table (A)

Part Number	Package	Freq Range (MHz)	Gain (dB)	Power Consumption		Max Out (dBmV)*	Max Comp Out (dBmV)*	CTB (dBc)	CSO (dBc)	XMOD (dBc)	CIN (dB)	Release Status	Technology
				Current (mA)	Voltage (V)								
RFPD3540	Hybrid	45-1218	28	420	24	59	68.8	-80	-80	-76	55	In Production	GaAs/GaN
QPA3333	MCM	45-1218	28	420	24	59	68.8	-80	-74	-75	60	In Production	GaAs/GaN
QPB8857	5x7 QFN	45-1218	28	440	24	57	66.8	-83	-81	–	60	In Production	GaAs
RFCM3316	MCM	45-1218	23	430	24	61	60.8	-73	-76	-65	60	In Production	GaAs/GaN
RFPD3210	Hybrid	45-1218	23	470	24	63	73.8	-73	-76	-68	57	In Production	GaAs/GaN
QPA3230	Hybrid	45-1218	23	370-470	24	63	73.8	-73	-76	-68	57	In Production	GaAs/GaN
RFCM3327	MCM	45-1218	23	370-470	24	63	73.8	-80	-80	-76	58	In Production	GaAs/GaN
RFCM3326	MCM	45-1218	25	430	24	61	60.8	-73	-76	-65	60	In Production	GaAs/GaN
RFPD3220	Hybrid	45-1218	25	470	24	63	73.8	-73	-76	-68	57	In Production	GaAs/GaN
QPA3240	Hybrid	45-1218	25	370-470	24	63	73.8	-73	-76	-68	57	In Production	GaAs/GaN
RFCM3328	MCM	45-1218	25	370-470	24	63	73.8	-80	-80	-76	58	In Production	GaAs/GaN
RFPD3580	Hybrid	45-1218	23	430-530	24-34	67	76.8	-73	-74	-68	55	In Production	GaAs/GaN
QPA3250	Hybrid	45-1218	23	430 - 530	34	67	76.8	-73	-74	-68	55	In Production	GaAs/GaN

*Virtual level, 190 QAM256 channels, 22 dB tilt actual level = virtual -6 dB

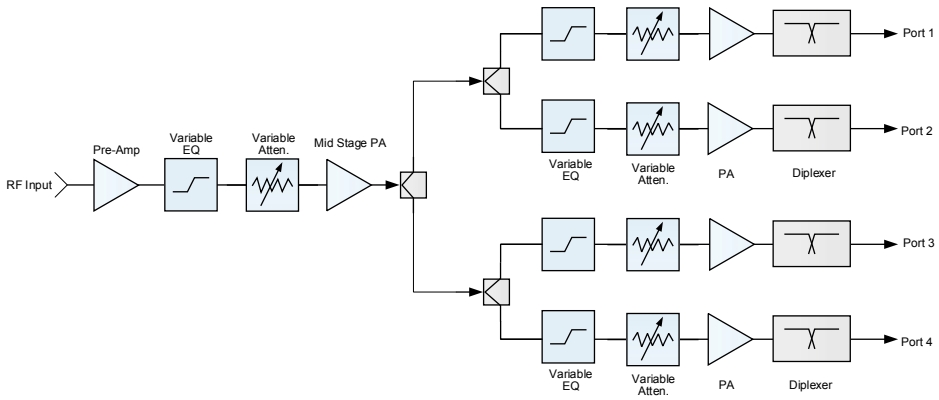
1.218 GHz DOCSIS 3.1 Push Pull Amplifiers (Interstage)

Table (B)

Part Number	Package	Freq Range (MHz)	Gain (dB)	Power Consumption		Pout (dBmV)*	CTB (dBc)	CSO (dBc)	XMOD (dBc)	CIN (dB)	Release Status	Technology
				Current (mA)	Voltage (V)							
RFPP2590	Hybrid	45-1200	24	230	24	43	-64	-70	-60	66	In Production	GaAs
QPB8858	5x7 QFN	47-1218	34	290	24	47	-75	-70	–	65	In Production	GaAs
RFAM3790	MCM	45-1218	28 (Var)	410	12	45	-67	-70	-60	64	In Production	GaAs
RFCM4363	MCM	45-1218	28	260	24	45	-72	-80	-65	70	In Production	GaAs/GaN
RFPP3870	Hybrid	45-1218	28	260	24	45	-72	-78	-63	69	In Production	GaAs/GaN
RFPP3180	Hybrid	45-1218	34	240	24	45	-66	-72	-62	64	In Production	GaAs
RFAM3620	MCM	45-1218	36 (Var)	510	12	46	-73	-75	-70	64	In Production	GaAs
QPA8801	5x7 QFN	47-1218	11	395	12	47	-70	-72	–	68.5	Target March 2019	GaAs

*79 analog channels plus 111 QAM256 channels (ITU-T/J.83 annex B), -6 dB offset, flat

4 Port Optical Node, RF Launch AMP: CATV



1 GHz Power Doubler Amplifiers

Table (C)

Part Number	Package	Freq Range (MHz)	Gain (dB)	Power Consumption		Pout (dBmV)*	CTB (dBc)	CSO (dBc)	XMOD (dBc)	CIN (dB)	Release Status	Technology
				Current (mA)	Voltage (V)							
D10040180GT	Hybrid	40-1000	18	375	24	44	-64	-65	-60	–	In Production	GaAs
D10040180GTH	Hybrid	40-1000	18	420	24	52	-65	-67	-62	–	In Production	GaAs
D10040200GT	Hybrid	40-1000	20	375	24	44	-64	-65	-60	–	In Production	GaAs
D10040200GTH	Hybrid	40-1000	20	420	24	52	-65	-67	-62	–	In Production	GaAs
D10040220GT	Hybrid	40-1000	22	375	24	44	-64	-65	-60	–	In Production	GaAs
D10040220GTH	Hybrid	40-1000	22	420	24	52	-65	-67	-62	–	In Production	GaAs
QPA3223	Hybrid	40-1000	23	410	24	50	-70	-71	-65	62	In Production	GaAs/GaN
QPA3238	Hybrid	40-1000	23	370-470	24	61	-73	-76	-65	60	In Production	GaAs/GaN
QPA3340	Hybrid	40-1000	23	470	24	61	-73	-76	-65	60	In Production	GaAs/GaN
D10040240GT	Hybrid	40-1000	24	375	24	44	-64	-65	-60	–	In Production	GaAs
D10040240GTH	Hybrid	40-1000	24	420	24	52	-65	-67	-62	–	In Production	GaAs
TAT8888	Hybrid	50-1000	24	445	24	61	-75	-69	-65	58	In Production	GaAs/GaN
TAT9988	5x7 QFN	40-1000	24	445	24	60	-75	-69	-65	59	In Production	GaAs/GaN
D10040250GT	Hybrid	40-1000	25	375	24	44	-64	-65	-60	–	In Production	GaAs
D10040250GTH	Hybrid	40-1000	25	440	24	52	-65	-67	-62	–	In Production	GaAs
QPA3248	Hybrid	40-1000	25	370-470	24	61	-73	-76	-65	60	In Production	GaAs/GaN
QPA3350	Hybrid	40-1000	25	470	24	61	-73	-76	-65	60	In Production	GaAs/GaN
TAT8857A1H	SOIC16W	45-1000	25	350	24	53	-73	-74	-68	60	In Production	GaAs
D10040270GT	Hybrid	40-1000	27	375	24	44	-64	-65	-60	–	In Production	GaAs
D10040270GTH	Hybrid	40-1000	27	420	24	52	-65	-67	-62	–	In Production	GaAs
D10040270GTL	Hybrid	40-1000	27	325	24	40	-61	-63	-58	–	In Production	GaAs
RFPD3890	Hybrid	40-1000	27	370	24	56	-73	-70	-67	62	In Production	GaAs
QPB8957	5x7 QFN	50-1003	28	350	24	56	-78	-79	–	64	In Production	GaAs
D10040300GTH	Hybrid	40-1000	30	420	24	52	-65	-65	-62	–	In Production	GaAs

1 GHz Push Pull Amplifiers (Interstage)

Table (D)

Part Number	Package	Freq Range (MHz)	Gain (dB)	Power Consumption		Pout (dBmV)*	CTB (dBc)	CSO (dBc)	XMOD (dBc)	Release Status	Technology
				Current (mA)	Voltage (V)						
S10040140P1	Hybrid	40-1003	14	250	24	46	-64	-64	-55	In Production	GaAs
S10040180P1	Hybrid	40-1003	18	250	24	46	-68	-68	-59	In Production	GaAs
S10040200P	Hybrid	40-1003	20	255	24	46	-60	-63	-57	In Production	GaAs
S10040220GT	Hybrid	40-1003	22	230	24	42	-63	-59	-58	In Production	GaAs
S10040220P	Hybrid	40-1003	22	260	24	46	-66	-66	-59	In Production	GaAs
S10040230GT	Hybrid	40-1003	23	240	24	42	-63	-59	-58	In Production	GaAs
S10040240P	Hybrid	40-1003	24	250	24	46	-66	-66	-59	In Production	GaAs
S10040280GT	Hybrid	40-1003	28	250	24	42	-65	-63	-58	In Production	GaAs
TAT8858A1H	SOIC16W	40-1003	32	270	24	32	-69	-68	-61	In Production	GaAs
QPA3320	Hybrid	40-1003	34	280	24	44	-66	-65	-60	In Production	GaAs
QPB8958	5x7 QFN	50-1003	34	260	24	47	-75	-70	–	In Production	GaAs

Return Path Amplifiers

Table (E)

Part Number	Package	Freq Range (MHz)	Gain (dB)	Power Consumption Current (mA)	Power Consumption Voltage (V)	CTB (dBc)	CSO (dBc)	XMOD (dBc)	Release Status	Technology
R0605250L	Hybrid	5-65	25	133	24	-69	-70	-59	In Production	Si
R0605300L	Hybrid	5-65	30	133	24	-64	-68	-55	In Production	Si
R1005250L	Hybrid	5-100	25	133	24	-69	-70	-59	In Production	Si
RFRP2920	Hybrid	5-100	28	158	24	-72	-70	-64	In Production	Si
R1005300L	Hybrid	5-100	30	130	24	-64	-68	-55	In Production	Si
RFRP2241	Hybrid	5-100	30	130	24	-66	-70	-57	In Production	Si
R2005280L	Hybrid	5-210	28	135	24	-69	-70	-65	In Production	Si
R2005300L	Hybrid	5-210	30	138	24	-72	-72	-65	In Production	Si
R2005350L	Hybrid	5-210	35	158	24	-72	-72	-64	In Production	Si
RFCM5304	MCM	5-220	39 (Var)	205	12	-70	-70	-60	In Production	Si
R3005250L	Hybrid	5-300	25	138	24	-71	-75	-63	In Production	Si
R3005300L	Hybrid	5-300	30	148	24	-70	-72	-63	In Production	Si
RFRP3120	Hybrid	5-300	35	158	24	-70	-75	-63	In Production	Si
QPA5368	MCM	5-300	35.3	195	12	-72	-75	-63	In Production	Si

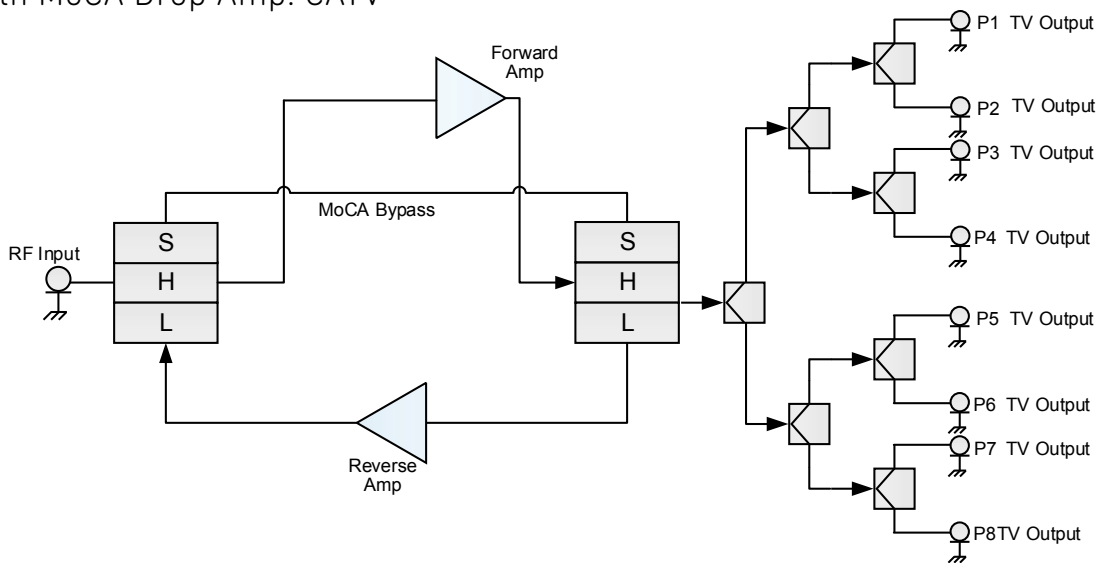
Medium and Low Power MMICs

Differential MMIC

Table (F)

Part Number	Package	Freq Range (MHz)	Product Description	Gain (dB)	P1dB (dBm)	Output IP3 (dBm)	Noise Figure (dB)	Vcc (V)	Icc (mA)	Release Status
CGR0118Z	SOIC 8	5-65	Dual Reverse Amp	25.4	74	40	2.7	5	262	In Production
QPB2318	SOIC 8	5-210	Reverse Amp	15.5	26.2	48	3.8	5, 8	235	In Production
CGR0218Z	SOIC 8	5-210	Dual Reverse Amp	17.3	23	42	4	5	217	In Production
QPB2328	SOIC 8	5-210	Reverse Amp	17.8	27	46	3.5	5, 8	235	In Production
QPB8896	SOIC 8	5 -700	Reverse Amp (FDX)	25	22.6	38	1.8	5	275	In Production
RFCA1008	SOIC 8	5-1000	High Linearity RF Amplifier	17	23	40	4	5	217	In Production
QPB7464	SOIC 8	50-2600	Dual RF Amplifier	11.5	17.5	37	4.5	5	240	In Production
CGA6618Z	ESOP-8	50-1000	High Linearity RF Amplifier	13	21	39	5.4	5	160	In Production
AG606	SOIC 8	50-1000	Dual RF Amplifier	14	20.3	37	5	5	165	In Production
TAT7466	SOIC 8	50-1000	Dual RF Amplifier	14	–	40	4	5	190	In Production
TAT7472A1F	SOIC 8	50-1210	Dual RF Amplifier	15.4	24.5	44	2.5	5	320	In Production
RFCA8828	SOIC 8	50-1200	High Linearity RF Amplifier	16.4	25	44	2.75	5	293	In Production
CGA7718Z	SOIC 8	50-1000	Dual RF Amplifier	17.4	23	41	4	5	215	NRND
TAT7469	SOIC 8	50-1200	Dual RF Amplifier(TIA)	17.5	–	38	3.2	5	250	In Production
TAT7467E1F	SOIC 8	50-1218	Dual RF Amplifier	18	25	43	4.7	5	380	In Production
TGA2807-SM	5x5 QFN	40-1000	Low Noise Linear Amplifier	18.5	–	40	2.3	6	318	In Production
RFCA8830	SOIC 8	45-1218	High Linearity RF Amplifier	19	24	40	2.5	5	280	In Production
TGA2803-SM	4x4 QFN	40-1218	RF Gain Block, TIA	20	–	42	1.5	8	350	In Production
QPB8808	5x7 QFN	50 -1218	Power Doubler	20.5	33	50	4.5	12	525	In Production
TAT8804D1H	5x7 QFN	50-1218	Power Doubler	21	34	49	4.5	12	650	In Production
QPB8857	5x7 QFN	50-1218	Power Doubler	28	30	53	4.5	24	440	In Production
QPB8957	5x7 QFN	50-1000	Power Doubler	28	28	51	4.5	24	350	In Production
QPB8858	5x7 QFN	50-1218	Push Pull	34	27	48	4.5	24	290	In Production
QPB8958	5x7 QFN	50-1000	Push Pull	34	26	46	4.5	24	240	In Production
QPL8830	SOIC 8	45-1218	High Gain High Linearity	21	24	40	2.5	5	300	Target August 2019
QPL7434	4x4 QFN	47-1218	Dual 7432 TIA	25	–	–	–	5	220	Target September 2019

8 Port with MoCA Drop Amp: CATV



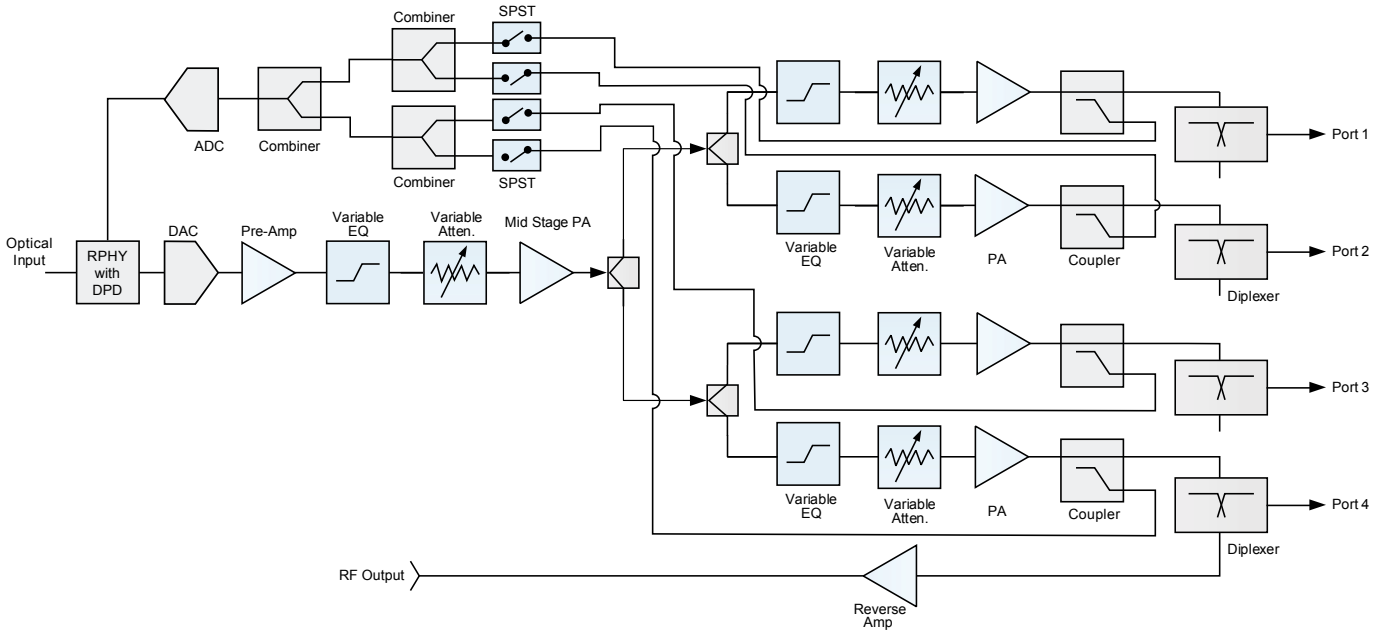
Single Ended MMIC

Table (G)

Part Number	Package	Freq Range (MHz)	Product Description	Gain (dB)	P1dB (dBm)	Output IP3 (dBm)	Noise Figure (dB)	Vcc (V)	Icc (mA)	Release Status
QPB3311	SOIC 8	5-210	Return Path RF Amplifier	15	23.5	48	3.8	5, 8	172	In Production
QPB3321	SOIC 8	5-210	Return Path RF Amplifier	17.5	24	48	3.4	5, 8	170	In Production
RFCA3310	SOT 89	5-1000	High Linearity Amplifier	14.5	22	33.5	3.6	8.5	147	In Production
RF3827	3x3 QFN	5-1500	General Purpose Amplifier	21	25	38	1.3	8	120	In Production
RF2312	SOIC 8	5-2500	High Linearity Amplifier	16	21	36	3.8	5 -12	100	In Production
RF2317	CJ2BATO	5-3000	Linear Amplifier	15	22	43	4.8	9	180	In Production
CXE1089Z	SOT 89	50-1000	Low Noise Amplifier	13	18.5	38.5	3	3-5	110	In Production
TAT7461	SOT 89	50-1000	General Purpose RF Amplifier	16.1	–	39	2.3	6	130	In Production
TAT7461A6A	SOT 89	50-1000	RF Amplifier 7461 Screened S22	16.1	–	36	2.3	6	130	In Production
TAT7427BT1	SOT 89	50-1000*	High Gain RF Amplifier	18.5	–	38	2.5	6-8	145	In Production
CXE2089Z	SOT 89	50-1000	Linear General Purpose Amplifier	20	23	36	1.5	7	105	In Production
RFCA3306	SOT 89	50-1000	High Linearity Amplifier	21	24.5	36.7	3	8	140	In Production
TAT7430B	SOT 89	50-1000*	High Gain RF Amplifier	22	22	41	2	5-8	190	In Production
QPB7400	SOT 89	47-1218	Adjustable Gain RF Amplifier	9-11	17	41	3.5	5	105	In Production
TAT7460	SOT 89	50-2600	General Purpose RF Amplifier	17	20.5	36	2.5	5	100	In Production
TAT7460B1A	SOT 89	50-2600	General Purpose RF Amplifier	17	20	38	3	5	90	In Production
TAT7457	SOT 89	50-1200	Adjustable Gain Amplifier, TIA	19	21	40	2.3	5 - 8	120	In Production
QPB7420	SOT 89	47-1218	Low Noise Amplifier	20	20	35.5	1.2	3, 5, 8	50	In Production
RFCA3828	SOT 89	50-1200	High Linearity Amplifier	21	22.5	39	1.54	6	169	In Production
QPB7425	SOT 89	47-1218	Low Noise Amplifier	25	24.7	39	1.1	3, 5, 8	105	In Production
QPB7432	SOT 89	47-1218	Low EINC Optical Rec Front End	32	20	–	0.6	5	105	In Production
QPB0066	6x6 MCM	5-500	Digital Controlled VGA	44	23	40	3.5	8	240	Target March 2019
QPL7433	3x3 QFN	44-3300	Low Noise Amplifier	17	20	37	2.5	5	85	Target October 2019

*Data sheet has graphs out to 1200 MHz

4 Port Optical Node with Feedback for DPD and Four SPST Switches



Control Products

Switches

Table (H)

Part Number	Product Description	Freq Range (MHz)	Impedance (Ω)	Insertion Loss (dB)	Isolation (dB)	P1/0.1dB (dBmV)	IP3 (dBm)	Vcc (V)	Package	Release Status
RFSW1012	SPDT Reflective Switch	5-2500	75	0.30	36	–	75	3-5	2x2 QFN	Production
QPC1022	SPDT Reflective Switch	5-6000	50	0.25	46	–	73	5	1.1x1.5 LGA	Production
QPC3024	SPDT Absorptive Switch	5-3000	75	0.82	66	36/36	61	3-5	4x4 QFN	Production
QPC6742	SP4T Reflective Switch	5-2000	75	0.40	30	40.2/34	82	3-5	1.8x1.8 QFN	Production
QPC6762	SP6T Reflective Switch	5-2000	75	0.40	34	37/33	75	3-5	2x2 QFN	Production
QPC4270	SPST Absorptive Switch	5-3000	75	0.30	60	37	65	3	3x3 QFN	Target June 2019
QPC7512	SPDT Reflective Switch	5-3300	75	0.30	36	–	75	3-5	2x2 QFN	Target November 2019
QPC7522	SPDT Reflective Switch	5 -3300	75	0.25	46	–	73	5	1.1x1.5 LGA	Target November 2019

Voltage Controlled Attenuators (VCAs)

Table (I)

Part Number	Product Description	Freq Range (MHz)	Impedance (Ω)	Insertion Loss (dB)	P1dB (dBm)	Range (dB)	IP3 (dBm)	Vcc (V)	Package	Release Status
RFSA3043	Voltage Controlled Attenuator	5-3000	75	1.5	30	30	50	3-5	3x3 QFN	Production
RFSA3023	Voltage Controlled Attenuator	50-3000	75	2.7	30	30	50	3.3	3x3 QFN	Production
RFSA3013	Voltage Controlled Attenuator	50-3000	75	2.5	30	30	50	5	3x3 QFN	Production

Digital Step Attenuators (DSAs)

Table (J)

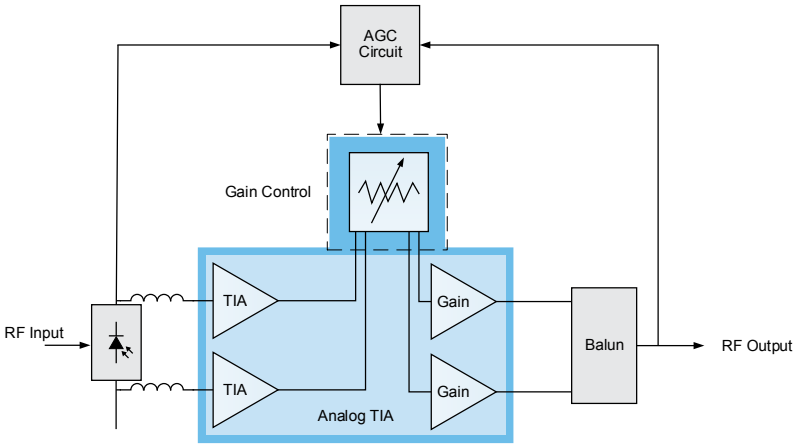
Part Number	Product Description	Freq Range (MHz)	Impedance (Ω)	Insertion Loss (dB)	Step Size (dB)	Range (dB)	IP3 (dBm)	Vcc (V)	Package	Release Status
QPC3624	6 Bit Digital Step Attenuator	47-2000	75	1.2	0.5	31.5	55	3.3	4x4 QFN	Production
QPC3614	6 Bit Digital Step Attenuator	5-1500	75	1.2	0.5	31.5	65	5	4.2x4.2 QFN	Production

Voltage Controlled Equalizer

Table (K)

Part Number	Product Description	Freq Range (MHz)	Impedance (Ω)	Insertion Loss (dB)	Return Loss (dB)	Tilt Range (dB)	IP3 (dBm)	Vcc (V)	Package	Release Status
QPC7336	Voltage Controlled Equalizer	45-1218	75	2.75	16	0.5-22	50	5	6x6 MCM	Production
QPC733x	Voltage Controlled Equalizer	5-700	75	2.75	16	0.5-15	50	5	6x6 MCM	Target December 2019

Optical Video RCVR for RFoG or XPON Receiver: Fiber to the Home



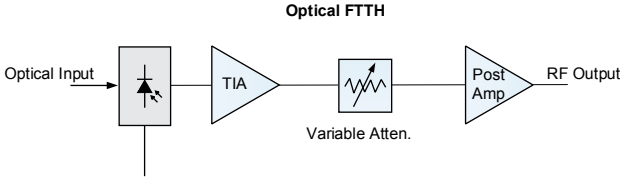
Optical

FTTH Optical Receive Amplifiers

Table (L)

Part Number	Package	Optical Rx	Freq Range (MHz)	Gain (dB)	Power Consumption Current (mA)	Power Consumption Voltage (V)	P_{OUT} dBmV/ Channel (dBmV)	Optical Input Power MIN/MAX (dBm)	Equivalent Input Noise (pA/rtHz)	Release Status
TAT6254B	4x4 QFN	Optical Video Receiver	47-1000	38	100	12	14	-12/-2	3.0	In Production
TAT6254C	4x4 QFN	Optical Video Receiver	47-1000	33	120	12	23	-10/+2	3.9	In Production
QPB8888	4x4 QFN	Optical Video Receiver	45-1218	37	130	12	23	-10/+2	3.5	In Production
QPB9015	11x11 MCM	xPON Optical Video Receiver with Integrated Attenuator	45-1218	37	300	5	23	-10/+2	3.5	In Production
QPB9010	11x11 MCM	xPON Optical Video Receiver with Integrated Attenuator	45-1218	37	135	12	23	-10/+2	3.5	In Production
RFOS6012, 3	Hybrid	Optical Receiver 1.2GHz Module	–	31	245	24	–	–	–	In Production
OS10040320PW	Hybrid	Optical Receiver 1GHz Module	–	32	255	24	–	–	–	In Production
OS10040280GW	Hybrid	Optical Receiver 1GHzm Module	–	28	245	24	–	–	–	In Production

Optical Reference Design



Transformers and Protection

Transformers

Table (M)

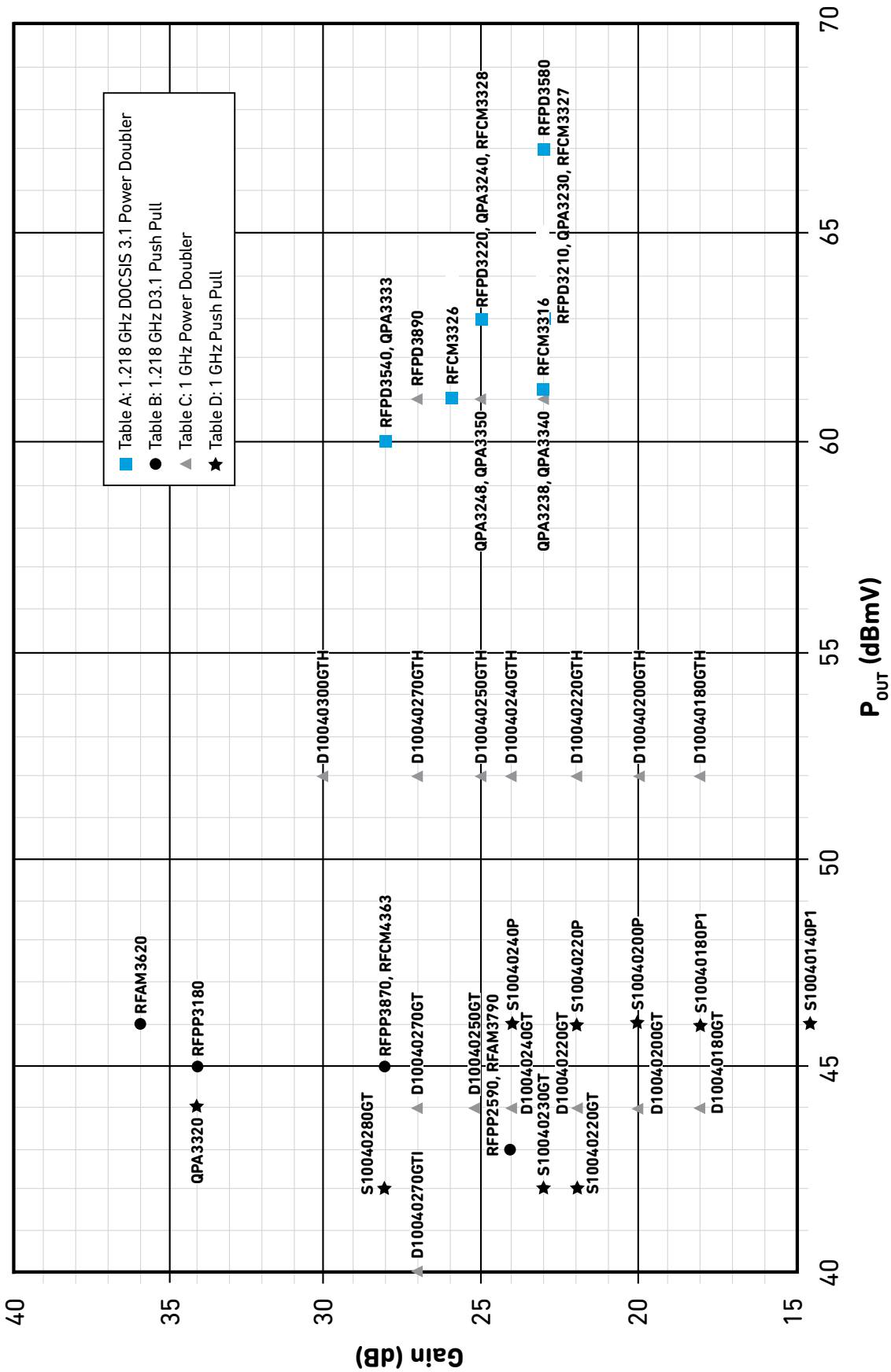
Part Number	Package	Freq Range (MHz)	Product Description	Insertion Loss @ 50MHz (dB)	Amplitude Balance (dB)	Phase Balance (deg)	Impedance Ratio	Input Return Loss (dB)	Type Transmission Line	Release Status
RFXF0006H	SP5	45-1218	1:1 SMT Transformer, 75 Ω	1.3	0.4	4	1:1	15	Unbalanced to Balanced	In Production
RFXF0007	SP5	45-1218	1:1 SMT Transformer, 75 Ω	0.4	1.4	7	1:1	13	Unbalanced to Balanced	In Production
RFXF0008H	SP6	45-1218	1:2.78 SMT Transformer, 75 Ω	1.6	0.3	2	1:2.78	14	Balanced to Balanced	In Production
RFXF0009H	SP5	45-1218	1:1 SMT Transformer, 75 Ω	0.4	1.3	5	1:1	25	Unbalanced to Balanced	In Production
RFXF0010	SP5	45-1218	1:1 SMT Transformer, 75 Ω	1.1	0.2	0.8	1:1	16	Unbalanced to Balanced	In Production

Protection

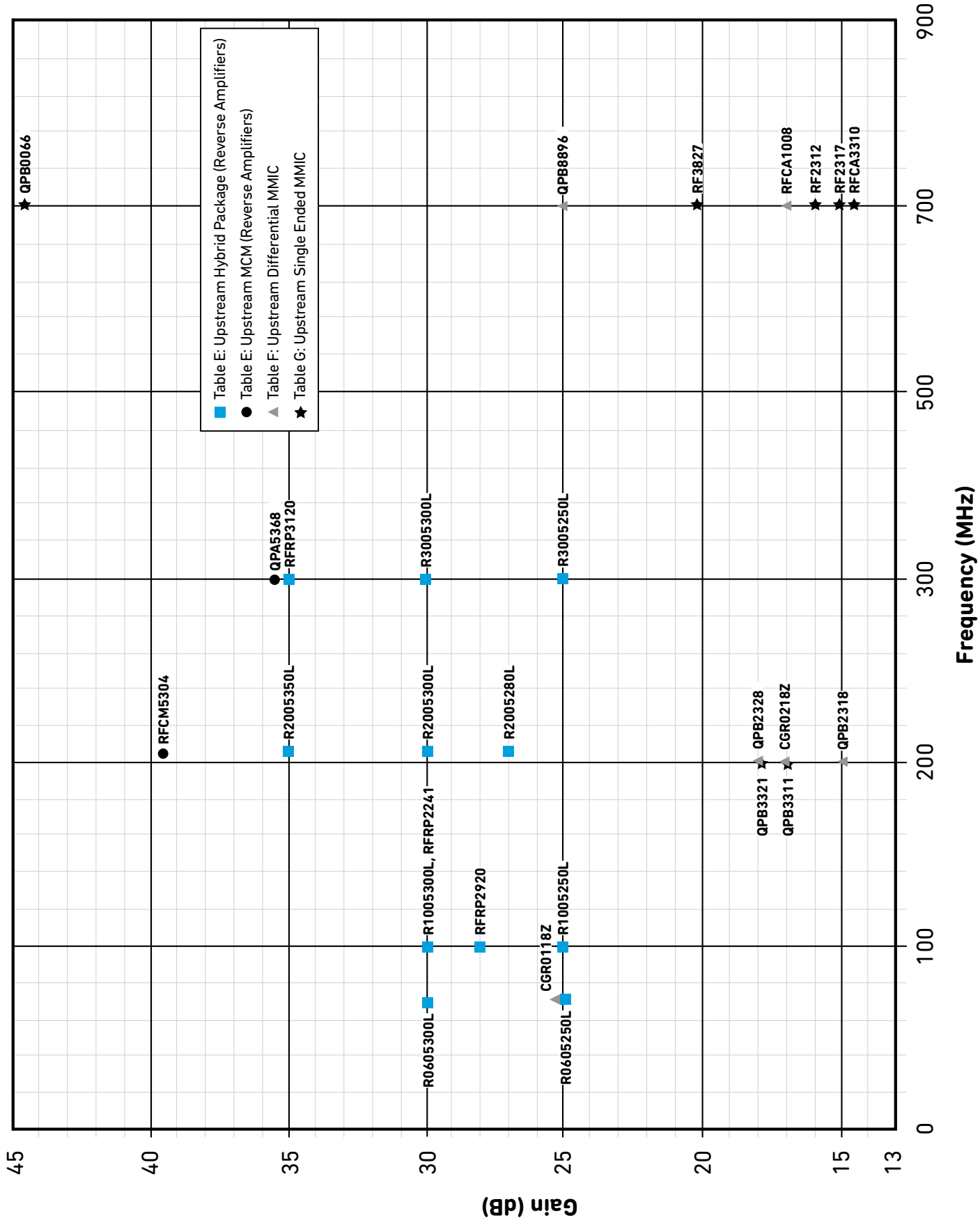
Table (N)

Part Number	Package	Freq Range (MHz)	Product Description	Insertion Loss @ 50MHz (dB)	Amplitude Balance (dB)	Phase Balance (deg)	Impedance Ratio	Input Return Loss (dB)	Type Transmission Line	Release Status
TQP200002	3pin TSLP	50-1200	ESD Protection Diode	0.3	41	-52	-63	15 @ 1V 300 @ 15V	220 @ 1V, 10MHz	In Production

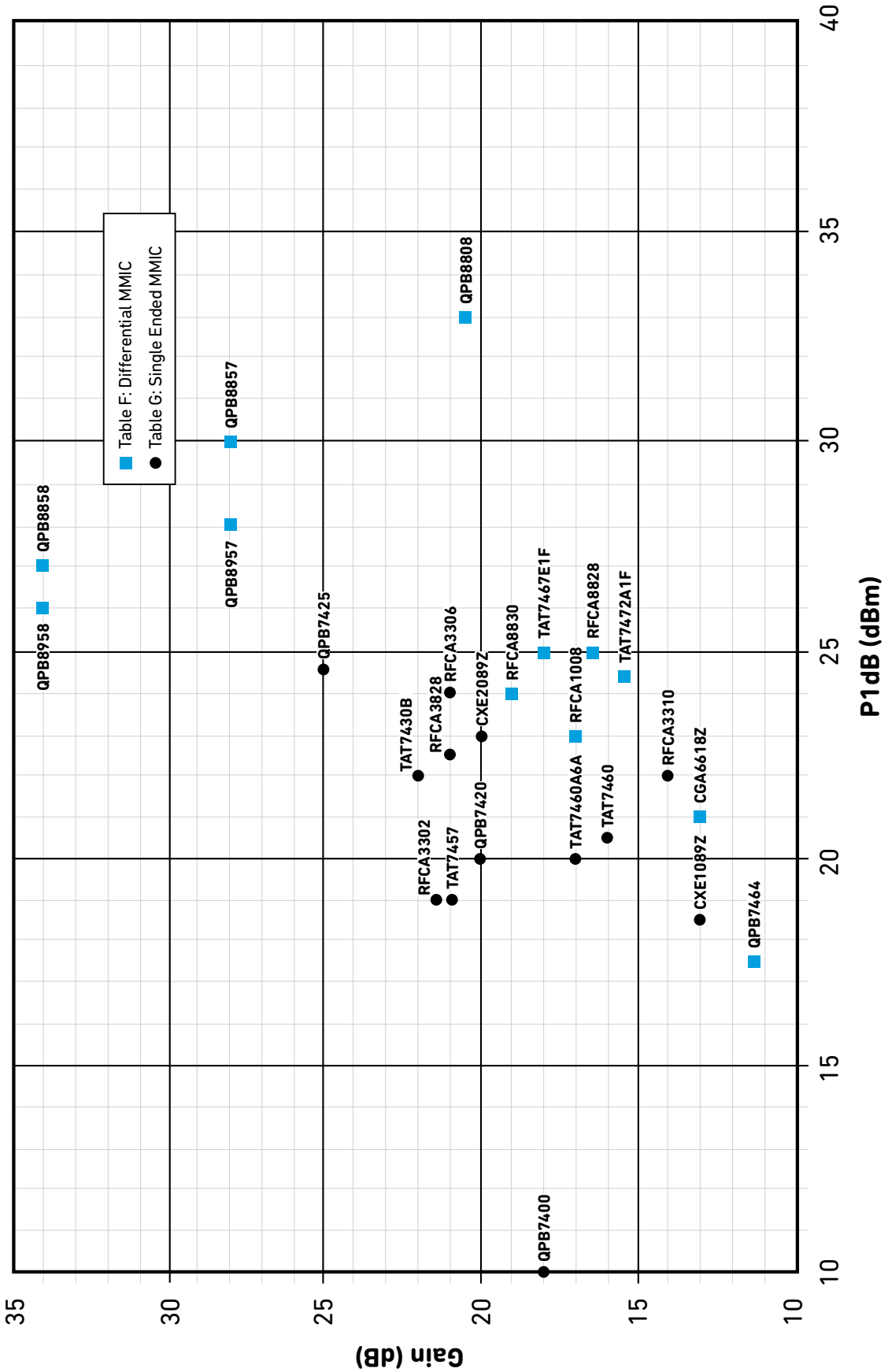
Downstream High-Power (40-67 dBmV)



Upstream Amplifiers



Downstream MMIC

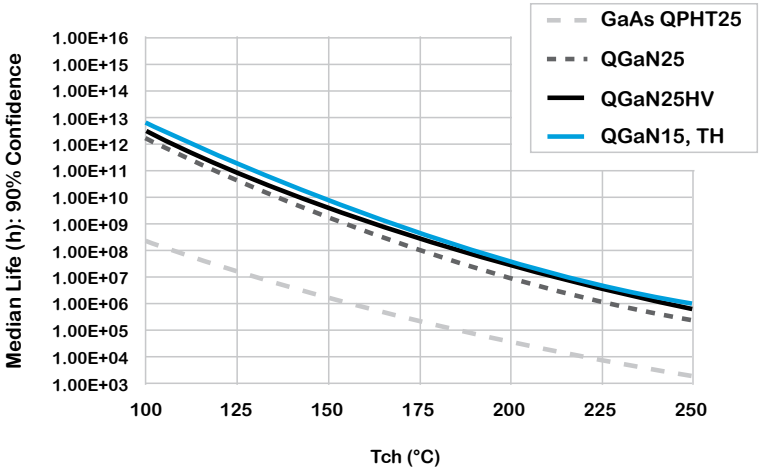


Gallium Nitride Innovation

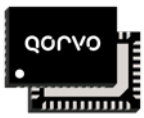
Qorvo has driven innovation and development of gallium nitride (GaN) products and technologies that enable next-generation systems for over 15 years. With Qorvo, not only are you getting world-class electrical performance, our partners also benefit from a 'trusted' supplier with industry-leading GaN reliability. Qorvo is also the only GaN supplier to reach manufacturing readiness level (MRL) 9.

Key Qorvo GaN attributes:

- >65 million device hours on 16,900 devices in the field, with less than 0.013% failures per million hours
- Applications from DC through W-band
- High power density
- Proven reliability at high junction temperatures, mean time to failure (MTTF) of greater than 10^7 (10 million) to 10^9 (1 billion) hours at 200 degrees (C) and greater than 10^6 (1 million) to 10^8 (100 million) hours at 225 degrees (C)



Guide to Qorvo CATV Product Packages

 LGA	 4x4 QFN	 SP5	 SP6
 MCM	 SOT115J	 5x7 QFN	 DFN (T/SLP-3)
 CJ2BATO	 SOIC16W	 SOIC8	 SOT89

1) All values are typical except where otherwise indicated.
2) Refer to individual product datasheets for test conditions.

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