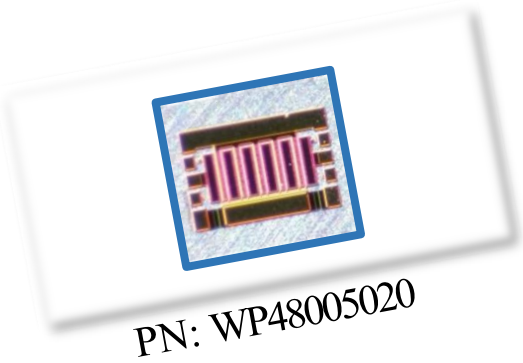
WAVE PIA IC DESIGN

WP48005020

20W, 48V GaN HEMT Die



The WP48005020 is a 20W gallium nitride (GaN) High Electron Mobility Transistor (HEMT). This GaN HEMT is a wideband transistor optimized for 5.8GHz operation in a user-friendly device for high bandwidth applications. Gallium nitride (GaN) HEMT is a device optimized for 5G. GaN HEMT resistance is only 1/10 that of silicon transistors, making it capable of switching frequencies faster for greater energy efficiency.

Features

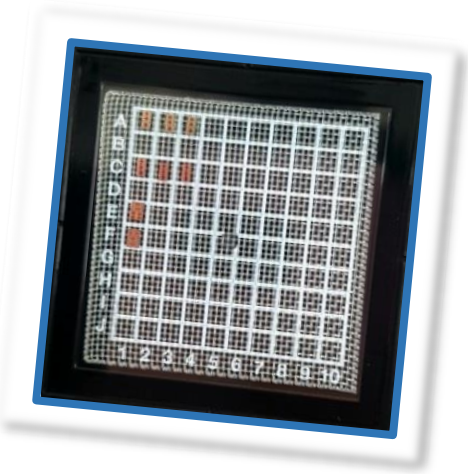
- Up to 6 GHz Operation
- 13.7 dB Typical Small Signal Gain @ 3.5 GHz
- 20 W Typical Psat @3.5GHz
- 48V Operation
- High Breakdown Voltage
- High Breakdown Voltage
- High Efficiency
- Reliability Monitoring Supporting

Applications

- U/VHF Amplifiers
- Broadband Amplifiers
- Base Station Communications
- Drone, UAV
- WiMAX, LTE, WCDMA, GSM
- WPT, V2X
- Radar application

Packaging Information

- Bare die are shipped in Wafer-level with Expander Ring or Gel-Pak® containers.
- Possible UV Curing for Wafer-level with dicing saw



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Absolute Maximum Ratings (not simultaneous) at 25˚C

Parameter	Parameter	Typical Value	Units	Conditions
Threshold voltage @ Id=1mA/mm, Vd=10V	V_{to}	-3.4	V	25°C
Breakdown voltage @ Id=1mA/mm	V_{DG}	160	V	25°C
Drain-source current, Id @ Vd=10V, Vg=0	I_{dss}	800	mA/mm	25°C
Operating Junction Temperature	T_J	225	°C	
Storage Temperature	T_{STG}	-65, +150	°C	
Thermal Resistance, Junction to Case (packaged)	$R_{\theta JC}$		°C/W	
Thermal Resistance, Junction to Case (die only)	$R_{\theta JC}$		°C/W	
Mounting Temperature (30 seconds)	T_S	320	°C	30 seconds

Electrical Characteristics (Frequency = 3.5 GHz unless otherwise stated; TC = 25˚C)

Parameter	Parameter	Typical Value	Units	Conditions
DC Characteristics				
Ohmic contact resistance	RC	0.3	Ohm-mm	25°C
Maximum Drain-source current, Id @ Vd=10V, Vg=1V (1X125μm device)	I_{dmax}	1000	mA/mm	25°C
Max. trans-conductance, @ Vd=10V, Vg=-4V ~ -1V (1X125μm device)	GM_PEAK	290	mS/mm	25°C
Maximum Drain-source current, Id @ Vd=10V, Vg=1V (1X125μm device)	I_{dmax}	1000	mA/mm	25°C
RF Characteristics				
Small Signal Gain	G_{SS}	13.7	dB	V_{DD}=48V, I_{DQ}=120mA
Saturated Power Output	P_{SAT}	20	W	V_{DD}=48V, I_{DQ}=120mA
Drain Efficiency	η	>60	%	V_{DD}=48V, I_{DQ}=120mA
Intermodulation Distortion	IM3	-30	dBc	V_{DD}=48V, I_{DQ}=120mA
Output Mismatch Stress	VSWR	10:1	ψ	

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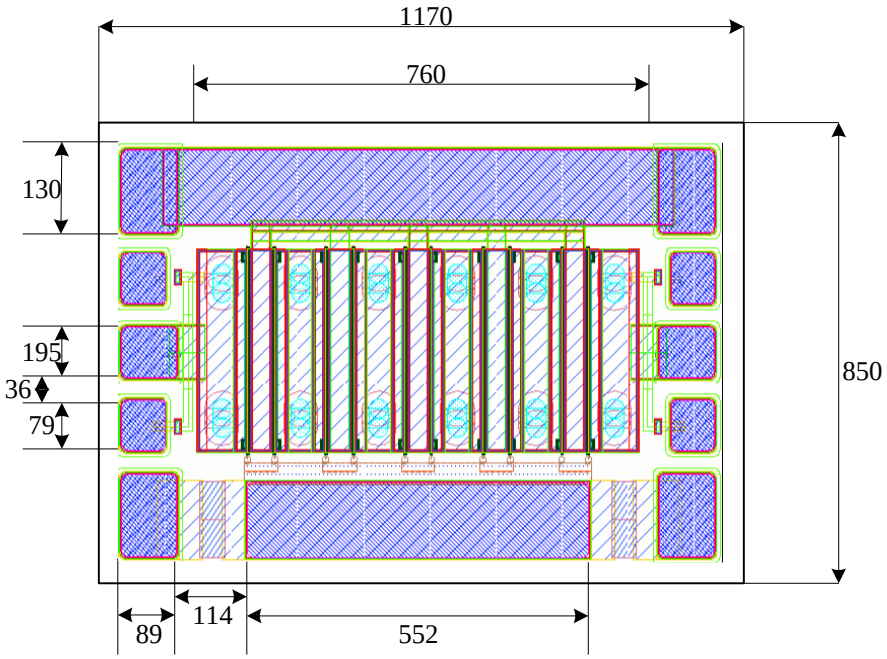
DIE Dimensions (units in microns)



Overall die size 1170 x 850 (+0/-50) microns, die thickness 100 (+/- 10) microns.
All Gate and Drain pads must be wire bonded for electrical connection.

Assembly Notes:

- Recommended solder is AuSn (80/20) solder. Refer to Wavepia's guide for the Eutectic Die Bond Procedure
- Vacuum collet is the preferred method of pick-up.
- The backside of the die is the Source (ground) contact.
- Die back side gold plating is 5 microns thick minimum.
- Thermosonic ball or wedge bonding are the preferred connection methods.
- Gold wire must be used for connections.

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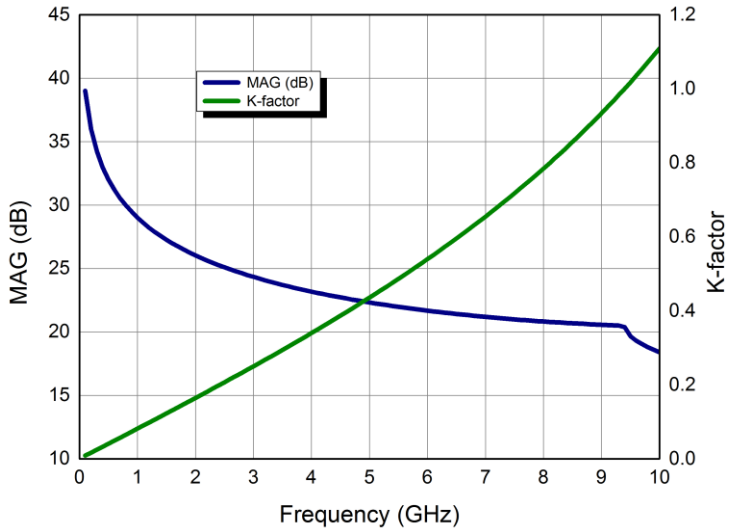
Typical Performance

Simulated Maximum Available Gain (MAG) and K Factor of the WP48005020

V_{DD} = 48 V, I_{DQ} = 120 mA

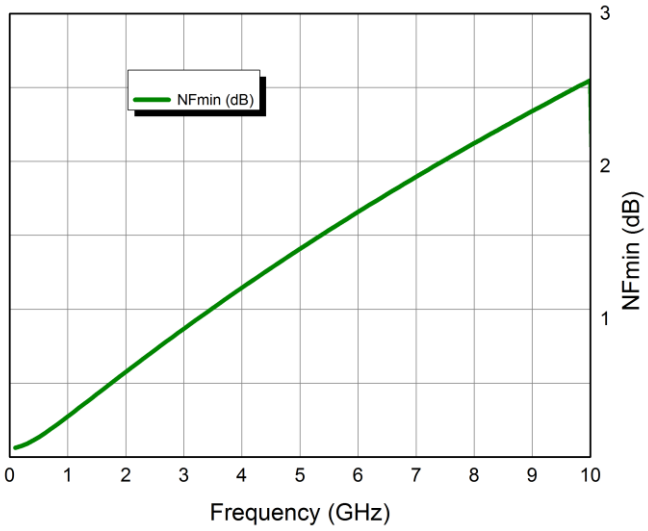


Intrinsic die parameters - reference planes at centers of gate and drain bonding pads. No wire bonds assumed.

Typical Performance

Simulated Minimum Noise Figure of the WP48005020

V_{DD} = 48 V, I_{DQ} = 120 mA



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Typical Die S-Parameters

(Small Signal, V_{DS} = 48 V, I_{DQ} = 120 mA, magnitude / angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
100MHz	0.995367	-23.4701	40.39557	166.712	0.005083	76.86115	0.500797	-15.8225
200MHz	0.98391	-45.1234	37.87717	154.4708	0.009532	64.76911	0.478878	-30.5012
300MHz	0.969753	-63.8743	34.55367	143.8718	0.013042	54.31939	0.450903	-43.3564
400MHz	0.956212	-79.4881	31.0878	135.0057	0.015642	45.60251	0.423189	-54.2351
500MHz	0.94476	-92.2573	27.85397	127.6723	0.017514	38.41839	0.399105	-63.3006
600MHz	0.935634	-102.662	24.99447	121.585	0.018853	32.48038	0.37972	-70.8265
700MHz	0.928549	-111.179	22.52612	116.4742	0.019816	27.51898	0.364913	-77.089
800MHz	0.923101	-118.213	20.41343	112.12	0.020514	23.31421	0.354115	-82.3279
900MHz	0.918915	-124.083	18.60583	108.3528	0.021025	19.69654	0.346667	-86.7404
1000MHz	0.915693	-129.035	17.05347	105.0447	0.0214	16.53807	0.341964	-90.4856
1100MHz	0.913207	-133.257	15.71265	102.0996	0.021676	13.74274	0.339498	-93.6906
1200MHz	0.911288	-136.894	14.54691	99.44507	0.021878	11.23805	0.338853	-96.4573
1300MHz	0.909811	-140.055	13.52653	97.02592	0.022024	8.968888	0.339697	-98.8673
1400MHz	0.908681	-142.827	12.62745	94.79979	0.022124	6.892861	0.341766	-100.986
1500MHz	0.907828	-145.276	11.8302	92.73371	0.02219	4.977048	0.344845	-102.867
1600MHz	0.907199	-147.457	11.11903	90.80184	0.022227	3.195586	0.348762	-104.552
1700MHz	0.906753	-149.41	10.48109	88.98361	0.02224	1.527945	0.353378	-106.076
1800MHz	0.906458	-151.171	9.905878	87.26257	0.022234	-0.04233	0.358578	-107.467
1900MHz	0.90629	-152.768	9.384725	85.62538	0.022211	-1.52857	0.364265	-108.747
2000MHz	0.90623	-154.223	8.910448	84.06116	0.022174	-2.94164	0.370361	-109.935
2100MHz	0.90626	-155.555	8.477052	82.56093	0.022124	-4.29049	0.376799	-111.046
2200MHz	0.906368	-156.78	8.079498	81.11728	0.022064	-5.58255	0.383521	-112.092
2300MHz	0.906545	-157.912	7.713532	79.72397	0.021993	-6.82403	0.390479	-113.084
2400MHz	0.90678	-158.961	7.375538	78.37577	0.021914	-8.02014	0.397631	-114.029
2500MHz	0.907068	-159.937	7.062424	77.06828	0.021828	-9.1753	0.404941	-114.935
2600MHz	0.907401	-160.848	6.771535	75.7977	0.021734	-10.2933	0.412377	-115.807
2700MHz	0.907774	-161.702	6.500581	74.56082	0.021634	-11.3772	0.419913	-116.65
2800MHz	0.908183	-162.504	6.247572	73.35484	0.021528	-12.43	0.427523	-117.467
2900MHz	0.908623	-163.26	6.010777	72.17738	0.021417	-13.454	0.435186	-118.262
3000MHz	0.909092	-163.974	5.788679	71.02633	0.0213	-14.4512	0.442885	-119.037
3100MHz	0.909586	-164.651	5.579947	69.89987	0.021179	-15.4235	0.450601	-119.796
3200MHz	0.910103	-165.293	5.383407	68.79639	0.021054	-16.3724	0.458322	-120.538
3300MHz	0.910639	-165.904	5.198018	67.71448	0.020925	-17.2995	0.466033	-121.267
3400MHz	0.911193	-166.487	5.022858	66.65289	0.020792	-18.2058	0.473723	-121.983
3500MHz	0.911764	-167.044	4.857102	65.61051	0.020656	-19.0925	0.481381	-122.687
3600MHz	0.912347	-167.577	4.700016	64.58635	0.020516	-19.9606	0.489	-123.381
3700MHz	0.912944	-168.089	4.550939	63.57952	0.020374	-20.811	0.49657	-124.065
3800MHz	0.913551	-168.581	4.409278	62.58921	0.020229	-21.6443	0.504084	-124.74
3900MHz	0.914167	-169.055	4.274498	61.61472	0.020081	-22.4615	0.511536	-125.406

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Typical Die S-Parameters

(Small Signal, V_{DS} = 48 V, I_{DQ} = 120 mA, magnitude / angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
4000MHz	0.914791	-169.511	4.146115	60.65537	0.019931	-23.2629	0.51892	-126.063
4100MHz	0.915423	-169.952	4.023689	59.71059	0.019779	-24.0494	0.526232	-126.713
4200MHz	0.916059	-170.379	3.906823	58.77983	0.019625	-24.8213	0.533467	-127.355
4300MHz	0.916701	-170.792	3.795154	57.86259	0.019469	-25.5792	0.540621	-127.99
4400MHz	0.917346	-171.193	3.688349	56.95841	0.019311	-26.3235	0.547691	-128.618
4500MHz	0.917995	-171.582	3.586107	56.06687	0.019152	-27.0546	0.554674	-129.239
4600MHz	0.918645	-171.961	3.488148	55.18758	0.018991	-27.7729	0.561567	-129.854
4700MHz	0.919296	-172.329	3.394217	54.32017	0.018829	-28.4787	0.568369	-130.462
4800MHz	0.919949	-172.688	3.30408	53.46432	0.018666	-29.1724	0.575077	-131.064
4900MHz	0.9206	-173.038	3.21752	52.61969	0.018502	-29.8542	0.581691	-131.66
5000MHz	0.921252	-173.38	3.134337	51.786	0.018336	-30.5244	0.588208	-132.249
5100MHz	0.921902	-173.714	3.054346	50.96296	0.01817	-31.1833	0.594629	-132.833
5200MHz	0.92255	-174.041	2.977374	50.15031	0.018004	-31.8311	0.600952	-133.41
5300MHz	0.923195	-174.361	2.903264	49.34779	0.017836	-32.4681	0.607178	-133.982
5400MHz	0.923838	-174.674	2.831867	48.55518	0.017668	-33.0945	0.613305	-134.548
5500MHz	0.924478	-174.982	2.763044	47.77225	0.0175	-33.7104	0.619334	-135.109
5600MHz	0.925114	-175.284	2.696669	46.99877	0.017331	-34.3161	0.625265	-135.663
5700MHz	0.925746	-175.58	2.63262	46.23454	0.017162	-34.9117	0.631097	-136.213
5800MHz	0.926374	-175.872	2.570785	45.47938	0.016992	-35.4975	0.636833	-136.756
6000MHz	0.926997	-176.158	2.51106	44.73307	0.016823	-36.0735	0.642471	-137.295
6100MHz	0.927615	-176.44	2.453346	43.99545	0.016653	-36.64	0.648012	-137.828
6200MHz	0.928228	-176.718	2.397551	43.26634	0.016484	-37.1971	0.653458	-138.355
6300MHz	0.928836	-176.991	2.343588	42.54557	0.016314	-37.7449	0.658809	-138.878
6400MHz	0.929439	-177.26	2.291375	41.83296	0.016144	-38.2836	0.664065	-139.395
6500MHz	0.930035	-177.526	2.240837	41.12838	0.015975	-38.8132	0.669229	-139.907
6600MHz	0.930626	-177.788	2.191899	40.43165	0.015806	-39.334	0.6743	-140.414
6700MHz	0.93121	-178.047	2.144495	39.74264	0.015637	-39.8461	0.67928	-140.916
6800MHz	0.931789	-178.303	2.09856	39.06119	0.015468	-40.3495	0.68417	-141.412
6900MHz	0.932361	-178.555	2.054032	38.38717	0.0153	-40.8444	0.688971	-141.904
7000MHz	0.932926	-178.804	2.010854	37.72043	0.015132	-41.3308	0.693684	-142.391
7100MHz	0.933485	-179.051	1.968972	37.06086	0.014965	-41.8089	0.698311	-142.874
7200MHz	0.934038	-179.295	1.928334	36.4083	0.014798	-42.2788	0.702852	-143.351
7300MHz	0.934584	-179.536	1.888891	35.76264	0.014631	-42.7405	0.707309	-143.824
7400MHz	0.935123	-179.775	1.850595	35.12376	0.014465	-43.1942	0.711684	-144.292
7500MHz	0.935655	179.9886	1.813404	34.49152	0.0143	-43.6398	0.715977	-144.755
7600MHz	0.936181	179.7545	1.777275	33.86582	0.014135	-44.0776	0.72019	-145.214
7700MHz	0.9367	179.5227	1.742168	33.24654	0.01397	-44.5076	0.724324	-145.668
7800MHz	0.937212	179.293	1.708045	32.63356	0.013807	-44.9298	0.728381	-146.118
7900MHz	0.937717	179.0653	1.67487	32.02677	0.013644	-45.3443	0.732361	-146.564

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