Filtronic

FPD1000AS

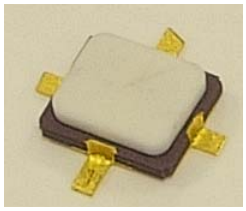
Datasheet v3.0

1W PACKAGED POWER PHEMT

FEATURES:

- 31 dBm Output Power (P1dB) @1.8GHz
- 15 dB Power Gain (G1dB) @ 1.8GHz
- 43 dBm Output IP3
- -42 dBc WCDMA ACPR at 21 dBm PCH
- 10V Operation
- 50% Power-Added Efficiency
- Evaluation Boards Available
- Suitable for applications to 5 GHz

PACKAGE



GENERAL DESCRIPTION:

The FPD1000AS is a packaged depletion mode AlGaAs/InGaAs pseudomorphic High Electron Mobility Transistor (pHEMT), optimized for power applications in L-Band. The surface-mount package has been optimized for low parasitics.

TYPICAL APPLICATIONS:

- Drivers or output stages in PCS/Cellular base station transmitter amplifiers
- Power applications in WLL/WLAN and WiMax amplifiers

ELECTRICAL SPECIFICATIONS:

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Power at 1dB Gain Compression	P1dB	VDS = 10V; IDS = 200 mA ΓS and ΓL tuned for Optimum IP3	30	31		dBm
Power Gain at 1dB Gain Compression	G1dB	VDS = 10V; IDS = 200 mA ΓS and ΓL tuned for Optimum IP3	13.5	15.0		
Maximum Stable Gain S21/S12	MSG	VDS = 10 V; IDS = 200mA PIN = 0dBm, 50Ω system		20		dB
Power-Added Efficiency at 1dB Gain Compression	PAE	VDS = 10V; IDS = 200 mA ΓS and ΓL tuned for Optimum IP3		50		%
3rd-Order Intermodulation Distortion ΓS and ΓL tuned for Optimum IP3	IM3	VDS = 10V; IDS = 200 mA POUT = 19 dBm (single-tone level)		-46		dBc
Saturated Drain-Source Current	IDSS	VDS = 1.3 V; VGS = 0 V	480	650	800	mA
Maximum Drain-Source Current	IMAX	VDS = 1.3 V; VGS ≅ +1 V		1100		mA
Transconductance	GM	VDS = 1.3 V; VGS = 0 V		720		mS
Gate-Source Leakage Current	IGSO	VGS = -3 V		20	50	μA
Pinch-Off Voltage	|VP|	VDS = 1.3 V; IDS = 2.4 mA	0.7	0.9	1.4	V
Gate-Source Breakdown Voltage	|VBDGS|	IGS = 2.4 mA	6			V
Gate-Drain Breakdown Voltage	|VBDGD|	IGD = 2.4 mA	20			V
Thermal Resistance (channel-to-case)	Θ_{CC}	See Note on following page		25		°C/W

Note: $T_{AMBIENT}$ = 22°; RF specification measured at f = 1850 MHz using CW signal (except as noted)

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ABSOLUTE MAXIMUM RATING[1]:

PARAMETER	SYMBOL	TEST CONDITIONS	ABSOLUTE MAXIMUM
Drain-Source Voltage	VDS	-3V < VGS < -0.5V [7]	12V
Gate-Source Voltage	VGS	0V < VDS < +8V	-3V
Drain-Source Current	IDS	For VDS > 2V	IDSS
Gate Current	IG	Forward or reverse current	+20/-20mA
RF Input Power [2]	PIN	Under any acceptable bias state	27.5dBm
Channel Operating Temperature	TCH	Under any acceptable bias state	175°C
Storage Temperature	TSTG	Non-Operating Storage	-40°C to 150°C
Total Power Dissipation [3]	PTOT	See De-Rating Note below	6W

Notes:
[1]$T_{Ambient}$ = 22°C unless otherwise noted; exceeding any one of these absolute maximum ratings may cause permanent damage to the device; Users should avoid exceeding 80% of 2 or more Limits simultaneously
[2]Max. RF Input Limit must be further limited if input VSWR > 2.5:1
[3]Total Power Dissipation defined as: $P_{TOT} \equiv (P_{DC} + P_{IN}) - P_{OUT}$,
where P_{DC}: DC Bias Power, P_{IN}: RF Input Power, P_{OUT}: RF Output Power
Total Power Dissipation to be de-rated as follows above 22°C:

P_{TOT}= 6 - (0.04W/°C) x T_{PACK}
where T_{PACK}= source tab lead temperature above 22°C
(coefficient of de-rating formula is the Thermal Conductivity)

Example: For a 55°C carrier temperature: P_{TOT} = 6W – (0.04 x (55 – 22)) = 4.68W
[5]For optimum heatsinking, metal-filled through (Source) via holes should be used directly below the central metallized ground pad on the bottom of the package
[6]Thermal Resistivity: The nominal value of 25°C/W is measured with the package mounted on a large heatsink with thermal compound to ensure adequate (unsoldered) contact. The package temperature is referred to the Source leads.
[7] Operating at absolute maximum VD continuously is not recommended. If operation is considered then IDS must be reduced in order to keep the part within it's thermal power dissipation limits. Therefore VGS is restricted to <-0.5V.

BIASING GUIDELINES:

- Active bias circuits provide good performance stabilization over variations of operating temperature, but require a larger number of components compared to self-bias or dual-biased. Such circuits should include provisions to ensure that Gate bias is applied before Drain bias, otherwise the pHEMT may be induced to self-oscillate. Contact your Sales Representative for additional information.
- Dual-bias circuits are relatively simple to implement, but will require a regulated negative voltage supply for depletion-mode devices such as the FPD1000AS.
- The recommended 200mA bias point is nominally a Class AB mode. A small amount of RF gain expansion prior to the onset of compression is normal for this operating point.

RECOMMENDED OPERATING BIAS CONDITIONS:

- Drain-Source Voltage: From 5V to 10V
- Quiescent Current: From 25% I_{DSS} to 55% I_{DSS}

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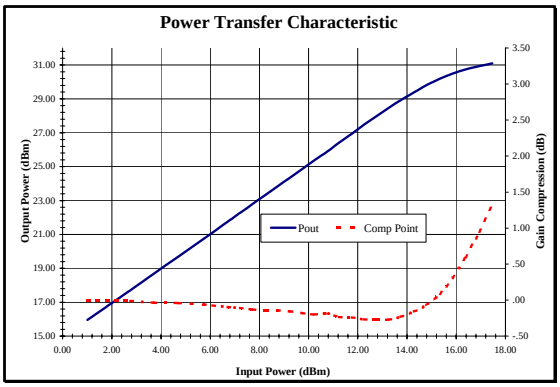
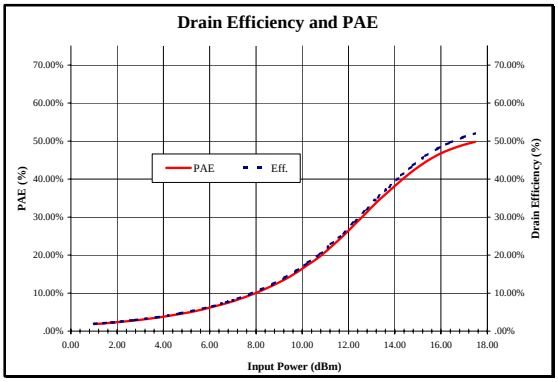
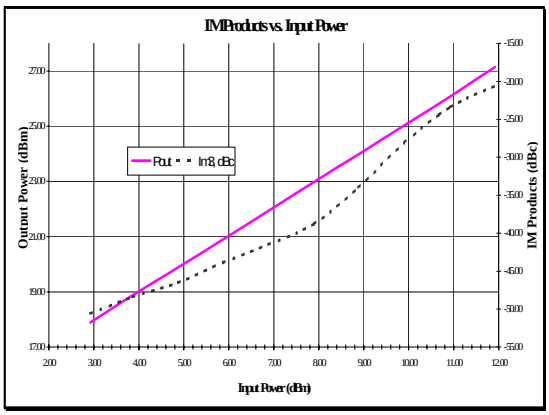
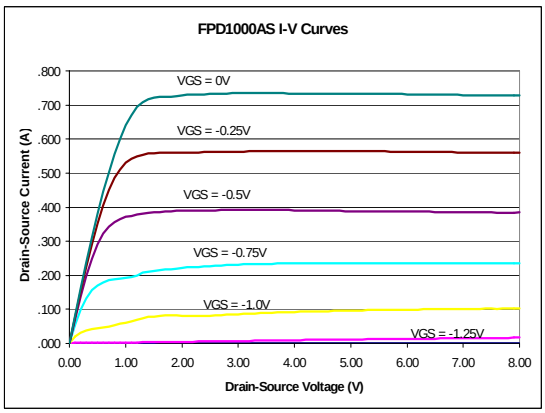
TYPICAL MEASURED RF PERFORMANCE:

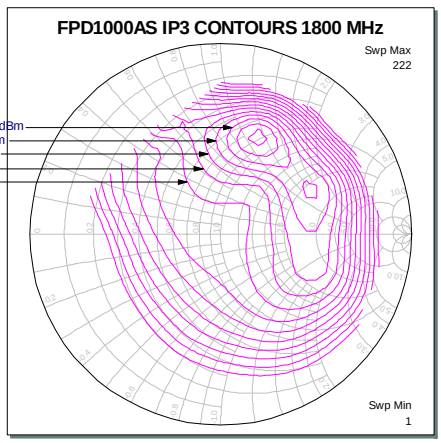
Note: Measurement Conditions $T_{AMBIENT}$ = 22°C unless otherwise stated (VDS=10V, IDS=200mA, f=1800MHz)



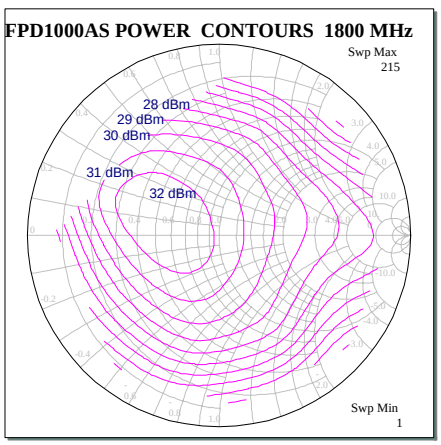








NOTE:
IP3 contours generated with P_{IN} = 11dB back-off from P_{1dB}. Local maxima for best linearity located at:
Γ_L = 40 + j55 Ω and Γ_L = 113 + j70 Ω
with Γ_S = 15 + j12 Ω



NOTE:
Power contours measured at constant input power level set to meet Optimum P1dB at the output match. Optimum match:
Γ_S = 3 – j2 Ω and Γ_L = 25 + j5 Ω

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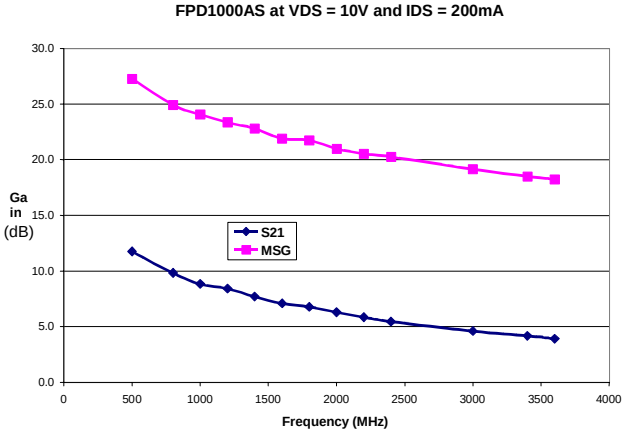
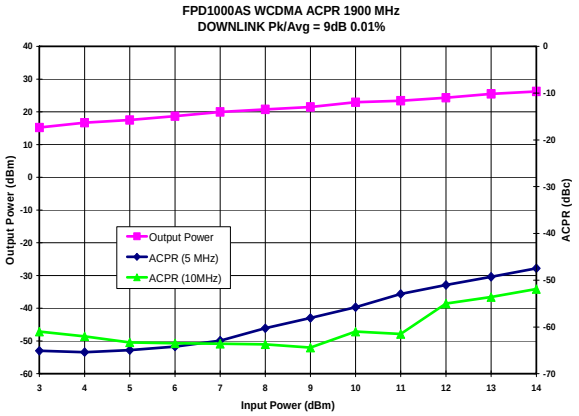
TYPICAL MEASURED RF PERFORMANCE:

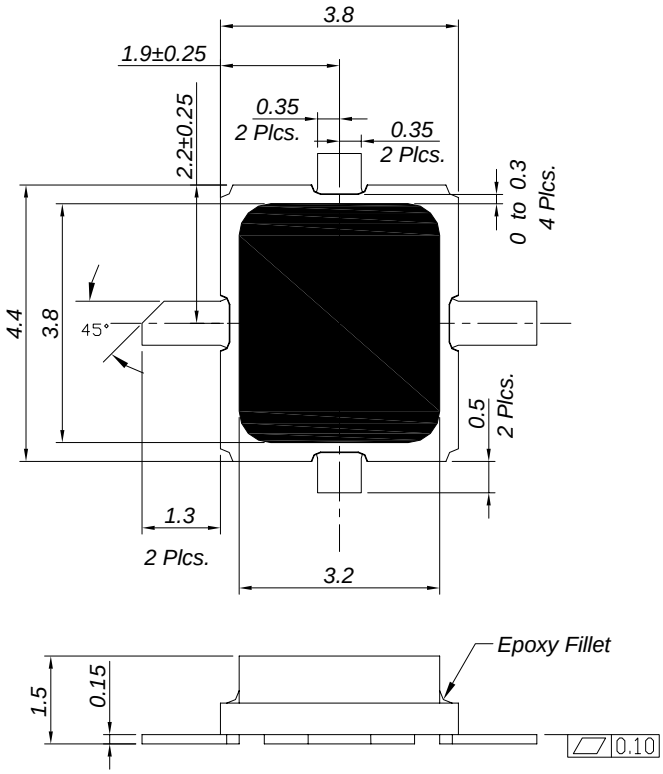
Note: Measurement Conditions $T_{AMBIENT}$ = 22°C unless otherwise stated (VDS=10V, IDS=200mA)

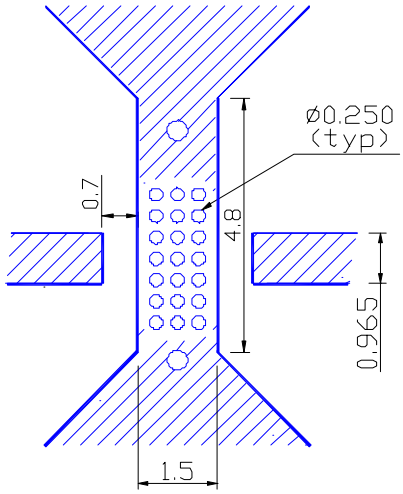




AS PACKAGE OUTLINE AND RECOMMENDED PC BOARD LAYOUT:

(dimensions in millimeters – mm)





All Dimnesions in mm
General Tolerance: .xx ± 0.05 .x ± 0.15
For best positional accuracy in auto pick and place
device should be referenced directly from the leads

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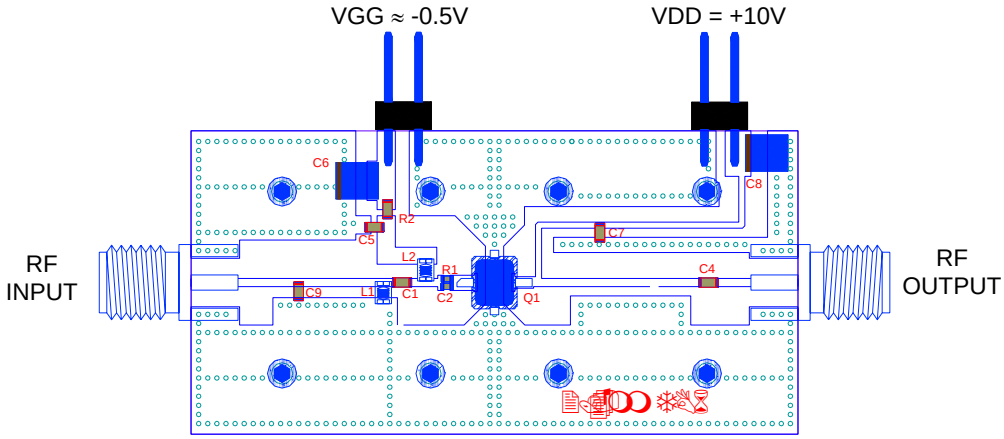
REFERENCE DESIGN AT 1.70 TO 1.85 GHZ:



NOTE: AutoCAD™ drawing available on request

DESIGNATOR	MANUFACTURER'S PART	DESCRIPTION	QUANTITY
C1	ATC600S3R9CW250	Capacitor, 3.9 pF, 0603, ATC 600, tol. ±0.25pF	1
C2	ATC600S5R6CW250	Capacitor, 5.6 pF, 0603, ATC 600, tol. ±0.25pF	1
C4	ATC600S330JW250	Capacitor, 33 pF, 0603, ATC 600, tol. ±5%	1
C5	ATC600S330JW250	Capacitor, 33 pF, 0603, ATC 600, tol. ±5%	1
C6	T491B105M035AS7015	Capacitor, 1 mF, SMD-B, Kemet, tol. ±20%	1
C7	ATC600S680JW250	Capacitor, 68 pF, 0603, ATC 600	1
C8	T491B105M035AS7015	Capacitor, 1 mF, SMD-B, Kemet, tol. ±20%	1
C9	ATC600S2R0BW250	Capacitor, 2 pF, 0603, ATC 600, tol. ±0.1pF	1
L1	0604HQ-1N1	Inductor, 1.1 nH, Coilcraft High Q Surface Mount	1
L2	0604HQ-1N1	Inductor, 1.1 nH, Coilcraft High Q Surface Mount	1
R1	RCI-0402-27R0J	Resistor, 27 W, 0402, IMS, tol. ±5%	1
R2	RCI-0603-12R0J	Resistor, 12 W, 0603, IMS, tol. ±5%	1
Q1	**FPD1000AS**	**1w Packaged Power pHEMT, Filtronic**	**1**
	PC-SP-000010-006	PCB, Rogers R04003, 0.012"(0.3mm), 0.5oz.	1
	TF-SP-000012	Carrier	1
	142-0711-841	Connector, RF, SMA End Launch, Jack Assy,	2
	AMP-103185-2	Connector, DC, 0.100 on center, 0.025 sq.	2
	TF-SP-000003	Center Block for P100 Package	1
		Screw, #0-80	8

NOTE: 10-12 mil (0.3mm) plated thru vias used; vias under Q1 should be filled with Dupont CB100 conductive via plugging material in order to achieve optimal heatsinking.

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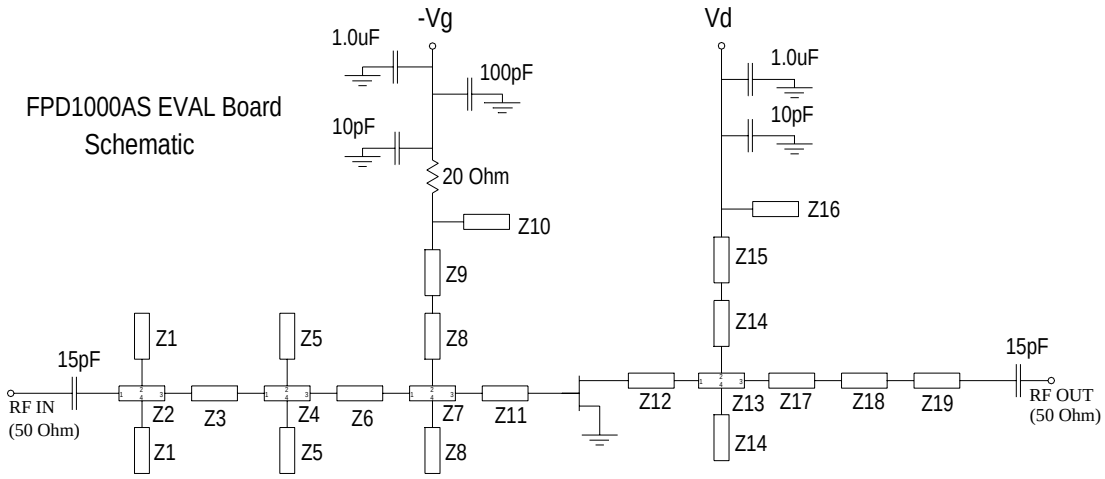
REFERENCE DESIGN AT 3.4 TO 3.5 GHZ:

PARAMETER	UNIT	PERFORMANCE
Frequency	GHz	3.4 to 3.5
Gain	dB	12
P1dB	dBm	31
IM3@19dBm Pout SCL	dBc	-46dBc
S11	dB	-5
S22	dB	-19
Vd	V	10
Vg	V	-0.6 to -0.9
Id	mA	200

SCHEMATIC:



Desc.	Value
Z1	0.040" x 0.930" Microstrip
Z2	W1=0.020" W2=0.040" W3=0.020" W4=0.040" Microstrip Cross
Z3	0.020" x 0.140" Microstrip
Z4	W1=0.020" W2=0.080" W3=0.020" W4=0.080" Microstrip Cross
Z5	0.080" x 0.100" Microstrip
Z6	0.020" x 0.350" Microstrip
Z7	W1=0.020" W2=0.060" W3=0.020" W4=0.060" Microstrip Cross
Z8	0.060" x 0.320" Microstrip
Z9	0.015" x 0.256" Microstrip
Z10, Z16	0.400" x 90° Microstrip Radial Stub
Z11, Z12	0.040" x 0.040" Microstrip
Z13	W1=0.040" W2=0.120" W3=0.040" W4=0.120" Microstrip Cross
Z14	0.120" x 0.220" Microstrip
Z15	0.015" x 0.330" Microstrip
Z17	0.040" x 0.320" Microstrip
Z18	0.150" x 0.140" Microstrip
Z19	0.030" x 0.270" Microstrip

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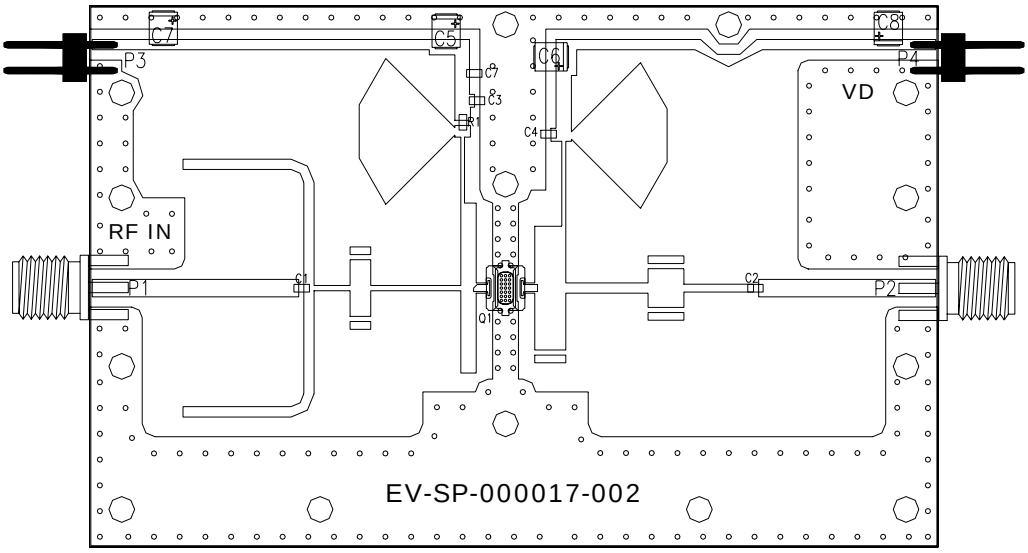
BOARD LAYOUT 3.4 TO 3.5 GHZ:



Component	Description
R1	Resistor 0.06 x 0.03 20Ω 1/4W
C1, C2	Cap. 0.06 x 0.03 15pF
C3, C4	Cap. 0.06 x 0.03 10pF
C5, C6, C7, C8	Cap. SMD-B 1.0uF
C7	Cap. 0.06 x 0.03 100pF
P1, P2	Edge Mount RF Connecter
P3, P4	2 Pin Header
Q1	FPD1000AS
PCB	EV-SP-000017-001 (R4003, 30mil Thick)
Base Plate	TF-SP-000019-001

NOTE: AutoCAD™ drawing available on request

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S-PARAMETERS:

Note: Biased @ 10V, 200mA

FREQ-GHZ	S11MAG	S11ANG	S21MAG	S21ANG	S12MAG	S12ANG	S22MAG	S22ANG
0.50	0.88	-128.80	15.67	106.53	0.03	28.11	0.28	-125.75
0.60	0.87	-138.81	13.51	100.36	0.03	24.30	0.28	-134.41
0.70	0.87	-146.73	11.82	95.18	0.03	21.50	0.28	-140.94
0.80	0.87	-153.30	10.51	90.63	0.03	19.18	0.28	-146.22
0.90	0.86	-158.82	9.47	86.53	0.03	17.49	0.28	-150.43
1.00	0.86	-163.57	8.59	82.82	0.03	15.99	0.28	-154.02
1.10	0.86	-167.75	7.86	79.41	0.03	14.99	0.28	-156.96
1.20	0.86	-171.53	7.23	76.19	0.03	13.89	0.28	-159.56
1.30	0.86	-174.94	6.72	73.13	0.03	13.12	0.28	-161.88
1.40	0.86	-178.08	6.26	70.17	0.03	12.20	0.28	-163.82
1.50	0.86	178.98	5.86	67.33	0.03	11.65	0.29	-165.60
1.60	0.86	176.28	5.51	64.62	0.03	11.00	0.29	-167.20
1.70	0.86	173.71	5.20	61.95	0.03	10.43	0.29	-168.79
1.80	0.86	171.32	4.93	59.34	0.03	10.09	0.29	-170.11
1.90	0.86	168.97	4.68	56.77	0.03	9.33	0.29	-171.44
2.00	0.85	166.76	4.46	54.27	0.03	9.11	0.29	-172.55
2.10	0.85	164.62	4.26	51.80	0.03	8.72	0.29	-173.63
2.20	0.85	162.52	4.07	49.34	0.04	8.23	0.30	-174.74
2.30	0.85	160.59	3.91	46.97	0.04	7.91	0.30	-175.59
2.40	0.85	158.68	3.75	44.57	0.04	7.48	0.30	-176.51
2.50	0.85	156.79	3.61	42.21	0.04	6.98	0.30	-177.41
2.60	0.85	154.99	3.48	39.86	0.04	6.55	0.30	-178.34
2.70	0.85	153.27	3.36	37.54	0.04	6.11	0.30	-179.07
2.80	0.85	151.54	3.25	35.25	0.04	5.76	0.31	-179.86
2.90	0.85	149.70	3.14	32.97	0.04	5.67	0.31	179.17
3.00	0.85	148.18	3.05	30.71	0.04	5.28	0.31	178.58
3.10	0.85	146.56	2.95	28.46	0.04	4.73	0.31	177.94
3.20	0.85	145.00	2.87	26.22	0.04	4.39	0.31	177.26
3.30	0.85	143.46	2.79	24.00	0.04	3.80	0.31	176.65
3.40	0.85	141.96	2.71	21.75	0.04	3.47	0.31	176.12
3.50	0.85	140.50	2.64	19.55	0.04	2.94	0.32	175.68
3.60	0.85	139.18	2.57	17.37	0.04	2.37	0.32	175.37
3.70	0.85	137.91	2.50	15.34	0.04	2.17	0.32	174.54
3.80	0.84	133.28	2.55	12.52	0.05	1.14	0.30	171.63
3.90	0.84	131.33	2.51	10.15	0.05	0.41	0.30	170.81
4.00	0.84	129.25	2.47	7.62	0.05	-0.73	0.30	169.88
4.10	0.83	127.24	2.42	5.19	0.05	-1.59	0.30	168.68
4.20	0.83	125.13	2.38	2.91	0.05	-2.45	0.30	167.57
4.30	0.83	123.09	2.34	0.60	0.05	-3.33	0.30	166.08
4.40	0.82	120.85	2.31	-1.66	0.05	-4.30	0.29	164.67
4.50	0.82	118.85	2.28	-4.25	0.05	-5.16	0.29	163.90
4.60	0.82	116.97	2.24	-6.61	0.06	-6.12	0.29	162.91
4.70	0.82	114.89	2.21	-8.92	0.06	-7.13	0.29	161.64
4.80	0.82	112.68	2.18	-11.33	0.06	-7.96	0.29	160.21
4.90	0.82	110.43	2.15	-13.72	0.06	-8.99	0.29	158.83

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S-PARAMETERS (CONT.):

Biased 10V, 200mA

FREQ-GHZ	S11MAG	S11ANG	S21MAG	S21ANG	S12MAG	S12ANG	S22MAG	S22ANG
5.00	0.82	108.18	2.13	-16.13	0.06	-9.98	0.29	157.42
5.10	0.81	105.83	2.10	-18.60	0.06	-11.10	0.29	155.91
5.20	0.81	103.46	2.08	-21.11	0.06	-12.35	0.29	154.46
5.30	0.81	101.13	2.05	-23.59	0.07	-13.63	0.29	152.90
5.40	0.81	98.72	2.03	-26.08	0.07	-14.83	0.29	151.36
5.50	0.81	96.33	2.00	-28.59	0.07	-16.07	0.29	149.74
5.60	0.80	93.92	1.98	-31.11	0.07	-17.49	0.29	148.11
5.70	0.80	91.39	1.96	-33.62	0.07	-18.72	0.29	146.28
5.80	0.80	88.80	1.93	-36.18	0.07	-20.03	0.29	144.50
5.90	0.80	86.30	1.91	-38.70	0.07	-21.39	0.29	142.74
6.00	0.80	83.78	1.89	-41.23	0.07	-22.73	0.29	141.04
6.10	0.80	81.27	1.87	-43.77	0.08	-24.19	0.29	139.39
6.20	0.80	78.66	1.85	-46.41	0.08	-26.10	0.29	137.34
6.30	0.80	76.05	1.82	-49.03	0.08	-27.81	0.29	135.24
6.40	0.80	73.44	1.80	-51.60	0.08	-29.44	0.29	133.07
6.50	0.80	70.67	1.78	-54.20	0.08	-30.98	0.29	130.98
6.60	0.79	67.95	1.75	-56.75	0.08	-32.63	0.29	128.65
6.70	0.79	65.31	1.72	-59.02	0.08	-33.63	0.28	126.73
6.80	0.78	63.23	1.71	-60.71	0.08	-32.15	0.28	126.99
6.90	0.79	61.09	1.71	-63.43	0.09	-33.13	0.29	126.51
7.00	0.79	58.43	1.70	-66.42	0.09	-35.89	0.30	124.01
7.10	0.79	55.67	1.68	-69.26	0.09	-38.30	0.30	121.40
7.20	0.79	52.99	1.66	-71.95	0.09	-40.44	0.30	118.89
7.30	0.79	50.30	1.64	-74.59	0.09	-42.24	0.30	116.47
7.40	0.79	47.73	1.62	-77.04	0.10	-43.66	0.30	114.40
7.50	0.80	45.33	1.61	-79.49	0.10	-44.69	0.30	113.31
7.60	0.80	42.75	1.59	-82.36	0.10	-46.91	0.31	110.92
7.70	0.80	40.08	1.57	-85.07	0.10	-49.10	0.31	108.33
7.80	0.80	37.57	1.55	-87.69	0.10	-51.11	0.31	105.97
7.90	0.80	34.99	1.53	-90.32	0.11	-53.07	0.32	103.61
8.00	0.80	32.44	1.52	-92.91	0.11	-55.02	0.32	101.30
8.10	0.80	30.01	1.50	-95.45	0.11	-56.92	0.32	99.02
8.20	0.80	27.63	1.48	-97.99	0.11	-58.66	0.32	96.94
8.30	0.81	25.29	1.47	-100.59	0.11	-60.57	0.32	94.64
8.40	0.81	22.80	1.45	-103.20	0.11	-62.43	0.32	92.31
8.50	0.81	20.44	1.43	-105.74	0.11	-64.13	0.33	89.97
8.60	0.81	18.12	1.42	-108.27	0.12	-65.92	0.33	87.60
8.70	0.81	15.80	1.40	-110.78	0.12	-67.73	0.33	85.33
8.80	0.81	13.42	1.39	-113.31	0.12	-69.56	0.33	83.03
8.90	0.81	11.15	1.37	-115.81	0.12	-71.48	0.33	80.64
9.00	0.81	8.87	1.36	-118.27	0.12	-73.28	0.33	78.35
9.10	0.81	6.58	1.35	-120.72	0.12	-75.07	0.33	76.22
9.20	0.82	4.40	1.34	-123.22	0.13	-76.87	0.33	74.12
9.30	0.82	2.09	1.33	-125.78	0.13	-78.81	0.33	71.85
9.40	0.82	-0.07	1.32	-128.34	0.13	-80.75	0.34	69.43
9.50	0.82	-2.41	1.30	-130.90	0.13	-82.67	0.34	67.07
9.60	0.82	-4.64	1.29	-133.47	0.13	-84.62	0.34	64.55
9.70	0.82	-7.03	1.28	-136.06	0.13	-86.70	0.34	62.06
9.80	0.83	-9.45	1.27	-138.66	0.14	-88.65	0.34	59.65
9.90	0.82	-11.95	1.26	-141.19	0.14	-90.55	0.34	57.31
10.00	0.82	-14.29	1.25	-143.71	0.14	-92.29	0.34	54.97

Specifications subject to change without notice

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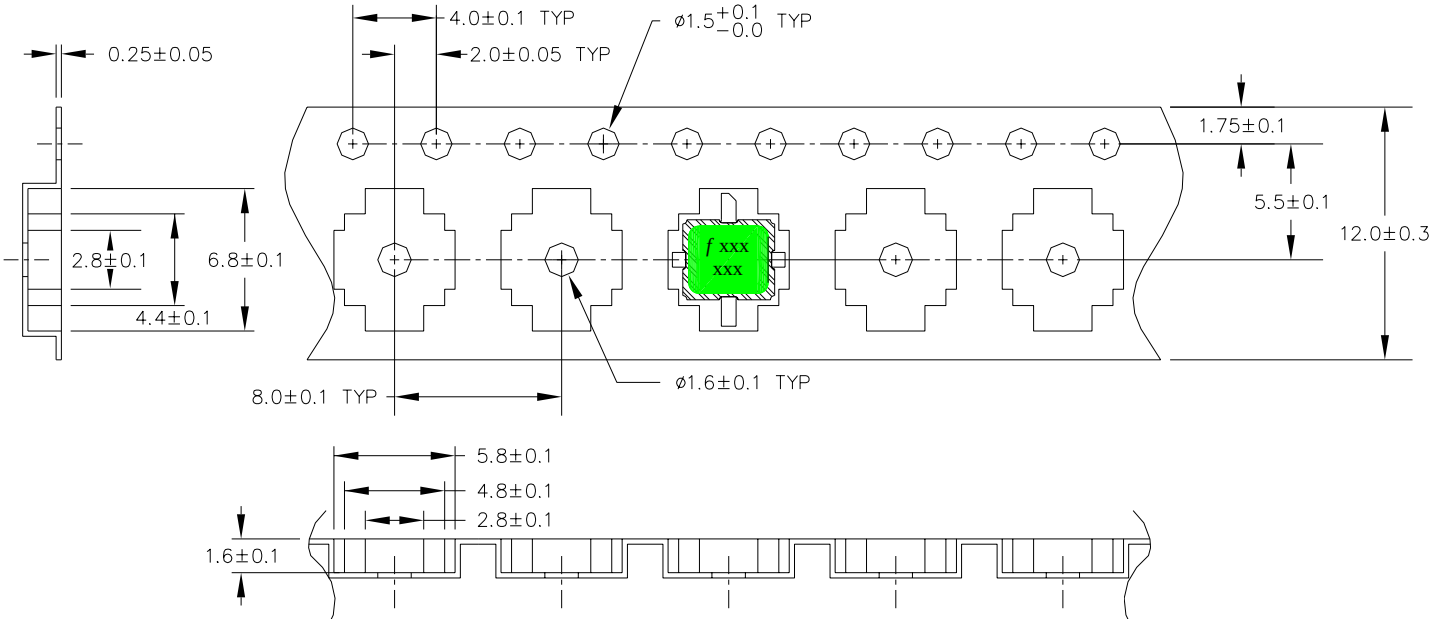
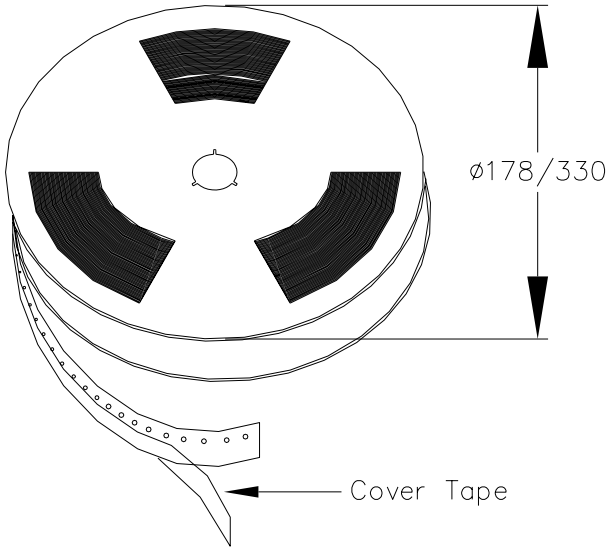
TAPE AND REEL DIMENSIONS AND PART ORIENTATION



DIMENSIONS ARE IN MM



PACKAGE MARKING CODE

Example:

***f*1ZD**
P2F

***f* = Filtronic**
1ZD = Lot / Date Code
P2F = Status, Part Code, Part Type
Parts per reel 178mm = 1000
330mm = 2500

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PREFERRED ASSEMBLY INSTRUCTIONS:

This package is compatible with both lead free and leaded solder reflow processes as defined within IPC/JEDEC J-STD-020C. The maximum package temperature should not exceed 260°C. Package leads are gold plated.

HANDLING PRECAUTIONS:

To avoid damage to the devices care should be exercised during handling. Proper Electrostatic Discharge (ESD) precautions should be observed at all stages of storage, handling, assembly, and testing.

ESD/MSL RATING:

These devices should be treated as Class 1A (250-500 V) as defined in JEDEC Standard No. 22-A114. Further information on ESD control measures can be found in MIL-STD-1686 and MIL-HDBK-263.

The device has a MSL rating of Level 1. To determine this rating, preconditioning was performed to the device per, the Pb-free solder profile defined within IPC/JEDEC J-STD-020C, Moisture / Reflow sensitivity classification for non-hermatic solid state surface mount devices

APPLICATION NOTES & DESIGN DATA:

Application Notes and design data including S-parameters, noise parameters and device model are available on request.

DISCLAIMERS:

This product is not designed for use in any space based or life sustaining/supporting equipment.

ORDERING INFORMATION:

PART NUMBER	DESCRIPTION
FPD1000AS	Packaged pHEMT
FPD1000AS-EB	Packaged pHEMT evaluation board EB-1000AS-AB (880MHz) EB-1000AS-AA (1.85GHz) EB-1000AS-AD (2.14GHz) EB-1000AS-AG (2.5 to 2.7GHz) EB-1000AS-AH (3.5GHz)

Specifications subject to change without notice
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