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HEWLETT PACKARD

4.8 V NPN Common Emitter Output Power Transistor for GSM Class IV Phones

Technical Data

AT-36408

Features

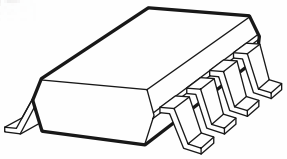
- **4.8 Volt Pulsed Operation (pulse width = 577 μsec, duty cycle = 12.5%)**
- **+35.0 dBm P_{out} @ 900 MHz, Typ.**
- **65% Collector Efficiency @ 900 MHz, Typ.**
- **9 dB Power Gain @ 900 MHz, Typ.**
- **Internal Input Pre-Matching Facilitates Cascading**

Applications

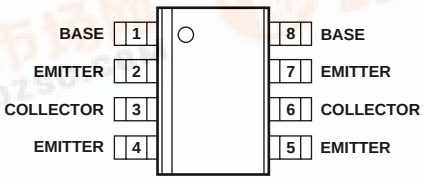
- **Output Power Device for GSM Class IV Handsets**

SOIC-8 Surface Mount Plastic Package

Outline P8



Pin Configuration



Description

Hewlett Packard's AT-36408 combines internal input pre-matching with low cost, NPN power silicon bipolar junction transistors in a SOIC-8 surface mount plastic package. This device is designed for use as the output device for GSM Class IV handsets. At 4.8 volts, the device features +35 dBm pulsed output power, superior power added efficiency, and excellent gain, making the AT-36408 an excellent choice for battery powered systems.

The AT-36408 is fabricated with Hewlett Packard's 10 GHz F_t Self-Aligned-Transistor (SAT) process. The die are nitride passivated for surface protection. Excellent device uniformity, performance and reliability are produced by the use of ion-implantation, self-alignment techniques, and gold metalization in the fabrication of these devices.

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AT-36408 Absolute Maximum Ratings

Symbol	Parameter	Units	Absolute Maximum[1]
V_{EBO}	Emitter-Base Voltage	V	1.4
V_{CBO}	Collector-Base Voltage	V	16.0
V_{CEO}	Collector-Emitter Voltage	V	9.5
I_C	Collector Current[2]	A	1.7
P_T	Peak Power Dissipation[2, 3]	W	8.6
T_j	Junction Temperature	°C	150
T_{STG}	Storage Temperature	°C	-65 to 150

Thermal Resistance[4]:
$\theta_{jc} = 60°C/W$

Notes:
1. Permanent damage may occur if any of these limits are exceeded.
2. Pulsed operation, pulse width = 577 µsec, duty cycle = 12.5%.
3. Derate at 133.3 mW/°C for $T_C > 85$ °C. T_C is defined to be the temperature of the collector pins 3 and 6, where the lead contacts the circuit board.
4. Using the liquid crystal technique, $V_{CE} = 4.5$ V, $I_c = 100$ mA, $T_j = 150$°C, 1 - 2 µm "hot-spot" resolution.

Electrical Specifications, $T_C = 25°C$

Symbol	Parameters and Test Conditions		Units	Min.	Typ.	Max.
	Freq. = 900 MHz, $V_{CE} = 4.8$ V, $I_{CQ} = 50$ mA, pulsed operation, pulse width = 577 µsec, duty cycle = 12.5%, Test Circuit A, unless otherwise specified					
P_{out}	Output Power[1]	$P_{in} = +26$ dBm	dBm	+34.0	+35.0	
η_C	Collector Efficiency[1]	$P_{in} = +26$ dBm	%	55	65	
H2	2nd Harmonic[1]	$F_0 = 900$ MHz	dBc		-50	
H3	3rd Harmonic[1]	$F_0 = 900$ MHz	dBc		-40	
	Mismatch Tolerance, No Damage[1]	$P_{out} = +35$ dBm any phase, 2 sec duration				7:1
BV_{EBO}	Emitter-Base Breakdown Voltage	$I_E = 0.8$ mA, open collector	V	1.4		
BV_{CBO}	Collector-Base Breakdown Voltage	$I_C = 4.0$ mA, open emitter	V	16.0		
BV_{CEO}	Collector-Emitter Breakdown Voltage	$I_C = 20.0$ mA, open base	V	9.5		
h_{FE}	Forward Current Transfer Ratio	$V_{CE} = 3$ V, $I_C = 180$ mA	—	80	150	330
I_{CEO}	Collector Leakage Current	$V_{CEO} = 5$ V	µA			50

Note:
1. With external matching on input and output, tested in a 50 ohm environment. Refer to Test Circuit A (GSM).

AT-36408 Typical Performance, T_C = 25°C

Frequency = 900 MHz, V_{CE} = 4.8 V, I_{CQ} = 50 mA, pulsed operation, pulse width = 577 µsec, duty cycle = 12.5%, Test Circuit A (GSM), unless otherwise specified.

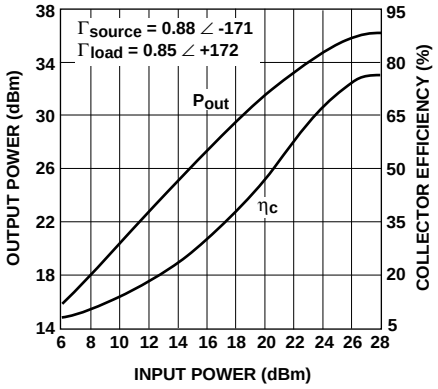


Figure 1. Output Power and Collector Efficiency vs. Input Power.

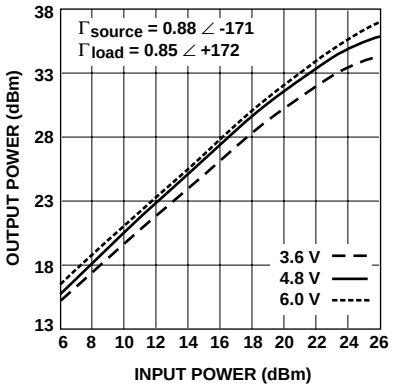


Figure 2. Output Power vs. Input Power Over Bias Voltage.

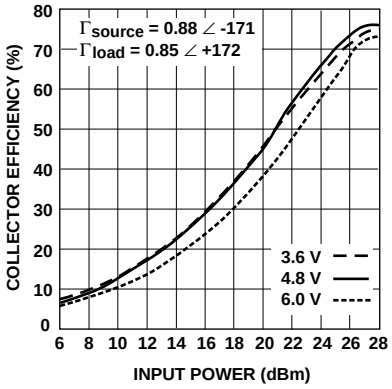


Figure 3. Collector Efficiency vs. Input Power Over Bias Voltage.

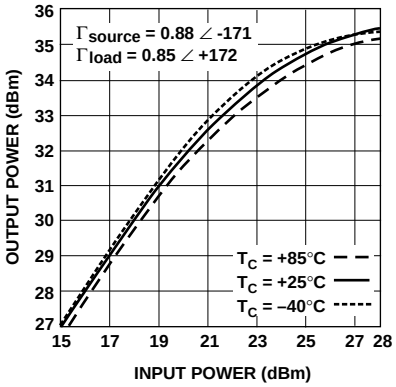


Figure 4. Output Power vs. Input Power Over Temperature.

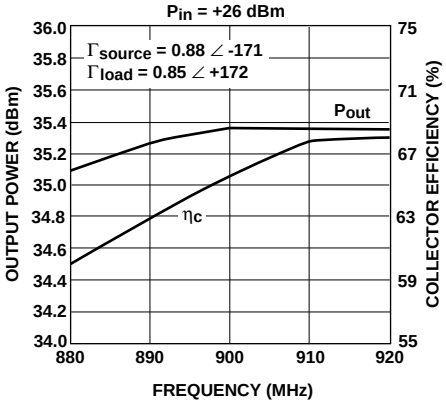


Figure 5. Output Power and Collector Efficiency vs. Frequency.

Note: Tuned at 900 MHz, then swept over frequency.

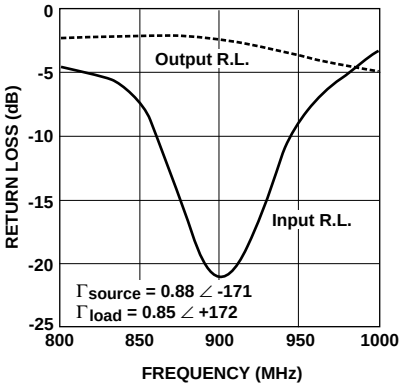


Figure 6. Input and Output Return Loss vs. Frequency.

AT-36408 Typical Large Signal Impedances

$V_{CE} = 4.8\,V, I_{CQ} = 50\,mA$, Pulsed Operation, $P_{out} = +35.0\,dBm$

Freq. MHz	Γ source		Γ load	
	Mag.	Ang.	Mag.	Ang.
880	0.882	-170.0	0.847	172.7
890	0.885	-170.5	0.849	172.2
900	0.887	-171.1	0.851	171.6
910	0.890	-171.4	0.853	171.1
915	0.891	-169.0	0.854	168.4
920	0.893	-168.4	0.855	168.2

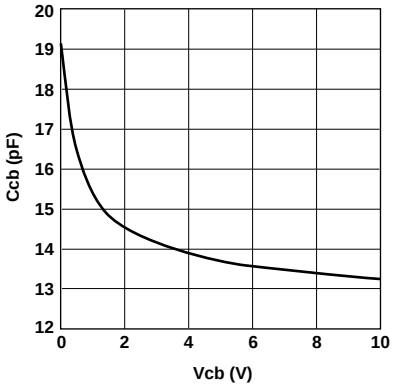
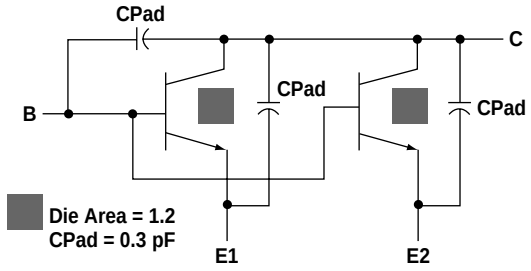


Figure 7. Collector-Base Capacitance vs. Collector-Base Voltage (DC Test).

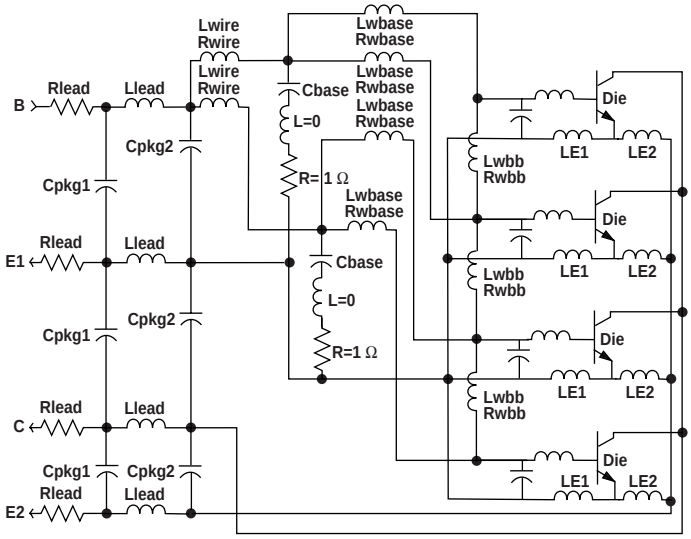
SPICE Model Parameters

Die Model



Label	Value	Label	Value
BF	280	TR	1E-9
IKF	299.9	EG	1.11
ISE	9.9E-11	IS	3.598E-15
NE	2.399	XTI	3
VAF	33.16	CJC	0.8E-12
NF	0.9935	VJC	0.4831
TF	1.6E-11	MJC	0.2508
XTF	0.006656	XCJC	0.001
VTF	0.02785	FC	0.999
ITF	0.001	CJE	6.16E-12
PTF	23	VJE	1.186
XTB	0	MJE	0.5965
BR	54.61	RB	0.752
IKR	81	IRB	0
ISC	8.7E-13	RBM	0.01
NC	1.587	RE	1.27
VAR	1.511	RC	0.107
NR	0.9886		

Packaged Model



Label	Value	Label	Value
Rlead	0.63 Ω	LE2	0.00064 nH
Llead	1.45 nH	Cbase	46.0 pF
Rwire	1.3 Ω	Rwbase	0.2 Ω
Lwire	0.52 nH	Lwbase	1.19 nH
Cpkg1	0.4 pF	Rwbb	0.1 Ω
Cpkg2	1.2 pF	Lwbb	0.1 nH
LE1	0.3 nH		

AT-36408 Typical Scattering Parameters, Common Emitter, $Z_O = 50\ \Omega$

$V_{CE} = 3.6\,V, I_c = 200\,mA, T_c = 25°C$

Freq.	S_{11}		S_{21}			S_{12}			S_{22}	
GHz	Mag.	Ang.	dB	Mag.	Ang.	dB	Mag.	Ang.	Mag.	Ang.
0.05	0.96	-175	22.3	13.08	93	-38.4	0.012	11	0.74	-169
0.10	0.96	-178	16.4	6.61	88	-37.7	0.013	13	0.74	-174
0.25	0.96	177	8.8	2.76	80	-36.5	0.015	24	0.75	-177
0.50	0.94	173	4.2	1.63	66	-34.4	0.019	33	0.73	-177
0.75	0.90	169	3.4	1.49	46	-32.0	0.025	27	0.71	-172
0.90	0.84	168	4.2	1.63	24	-32.0	0.025	10	0.72	-165
1.00	0.79	170	4.6	1.70	0	-34.0	0.020	-14	0.81	-160
1.25	0.92	175	-1.2	0.87	-68	-37.1	0.014	126	1.01	-172
1.50	0.97	169	-9.6	0.33	-98	-30.2	0.031	97	0.96	-177
$V_{CE} = 4.8\,V, I_c = 200\,mA, T_c = 25°C$										
0.05	0.96	-174	22.6	13.42	93	-37.7	0.013	11	0.74	-169
0.10	0.96	-178	16.6	6.79	88	-37.7	0.013	13	0.73	-174
0.25	0.96	178	9.0	2.83	80	-36.5	0.015	23	0.74	-177
0.50	0.94	173	4.4	1.66	66	-34.4	0.019	32	0.72	-176
0.75	0.90	169	3.6	1.51	46	-32.4	0.024	26	0.70	-172
0.90	0.84	168	4.3	1.64	24	-32.0	0.025	9	0.72	-164
1.00	0.80	170	4.6	1.71	0	-34.0	0.020	-14	0.81	-160
1.25	0.92	175	-1.0	0.89	-67	-37.1	0.014	126	1.01	-171
1.50	0.97	169	-9.4	0.34	-97	-30.2	0.031	97	0.96	-177
$V_{CE} = 6.0\,V, I_c = 200\,mA, T_c = 25°C$										
0.05	0.96	-174	22.7	13.60	93	-37.7	0.013	12	0.73	-169
0.10	0.96	-178	16.7	6.88	88	-37.1	0.014	14	0.72	-174
0.25	0.96	178	9.2	2.87	79	-35.9	0.016	23	0.73	-177
0.50	0.94	173	4.5	1.68	65	-34.0	0.020	30	0.71	-176
0.75	0.90	169	3.7	1.52	45	-32.0	0.025	24	0.69	-171
0.90	0.85	168	4.3	1.64	23	-32.0	0.025	8	0.72	-164
1.00	0.80	170	4.6	1.70	0	-34.0	0.020	-14	0.81	-159
1.25	0.92	175	-1.0	0.90	-67	-37.7	0.013	125	1.01	-171
1.50	0.97	169	-9.2	0.35	-97	-30.2	0.031	96	0.95	-177

Typical Performance

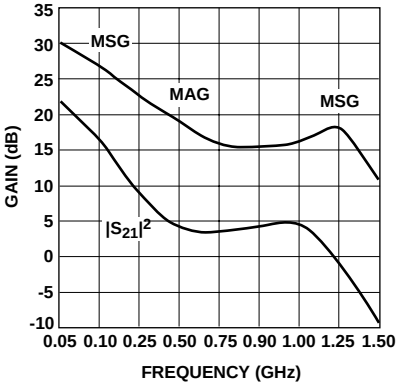


Figure 8. Insertion Power Gain, Maximum Available Gain, and Maximum Stable Gain vs. Frequency. V_{CE} = 3.6V, I_C = 200 mA.

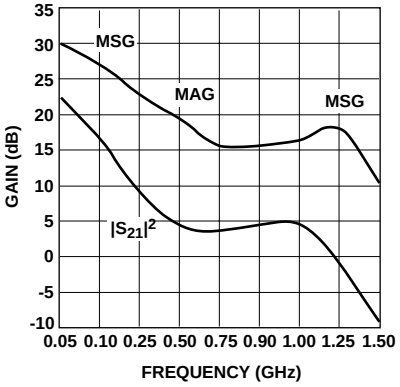


Figure 9. Insertion Power Gain, Maximum Available Gain, and Maximum Stable Gain vs. Frequency. V_{CE} = 4.8V, I_C = 200 mA.

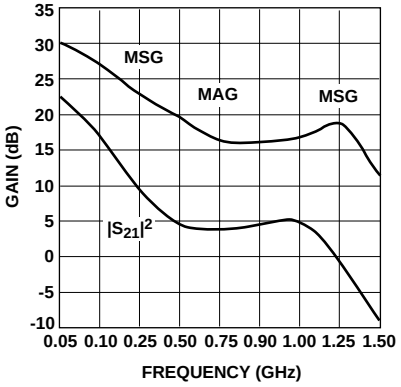
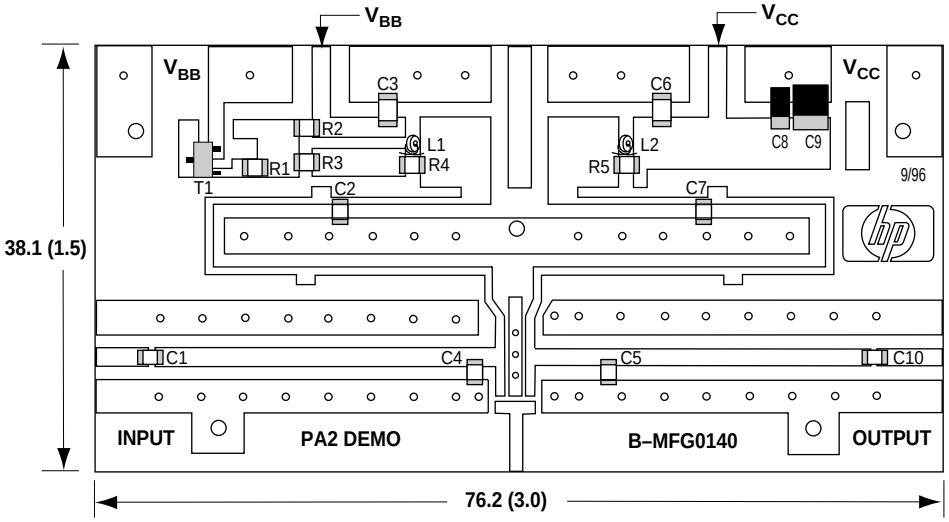


Figure 10. Insertion Power Gain, Maximum Available Gain, and Maximum Stable Gain vs. Frequency. V_{CE} = 6.0V, I_C = 200 mA.

Test Circuit A: Test Circuit Board Layout @ 900 MHz (GSM)

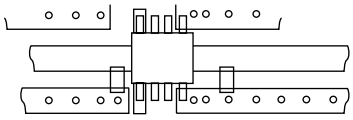


C1	39.0 pF
C2	39.0 pF
C3	100.0 nF
C4	12.5 pF
C5	11.5 pF
C6	100.0 nF
C7	39.0 pF
C8	1.5 µF
C9	10.0 µF
C10	39.0 pF
R1	2.2 Ω
R2	619.0 Ω
R3	2.2 Ω
R4	10.0 Ω
R5	10.0 Ω
T1	MBT 2222A
L1	18.0 µH
L2	18.0 µH

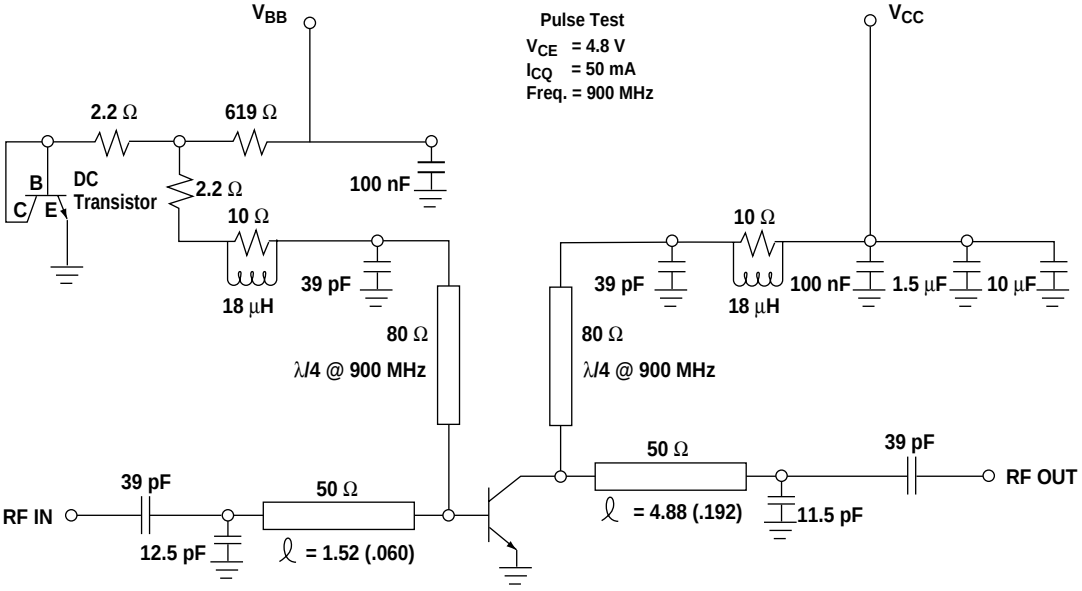
Pulse Test
V_{CE} = 4.8 V
I_{CQ} = 50 mA
Freq. = 900 MHz

Test Circuit:
FR-4 Microstrip, glass epoxy board
Dielectric Constant = 4.5
Thickness = 0.79 (.031)

NOTE:
Dimensions are shown in millimeters (inches).



Test Circuit A: Test Circuit Schematic Diagram @ 900 MHz (GSM)

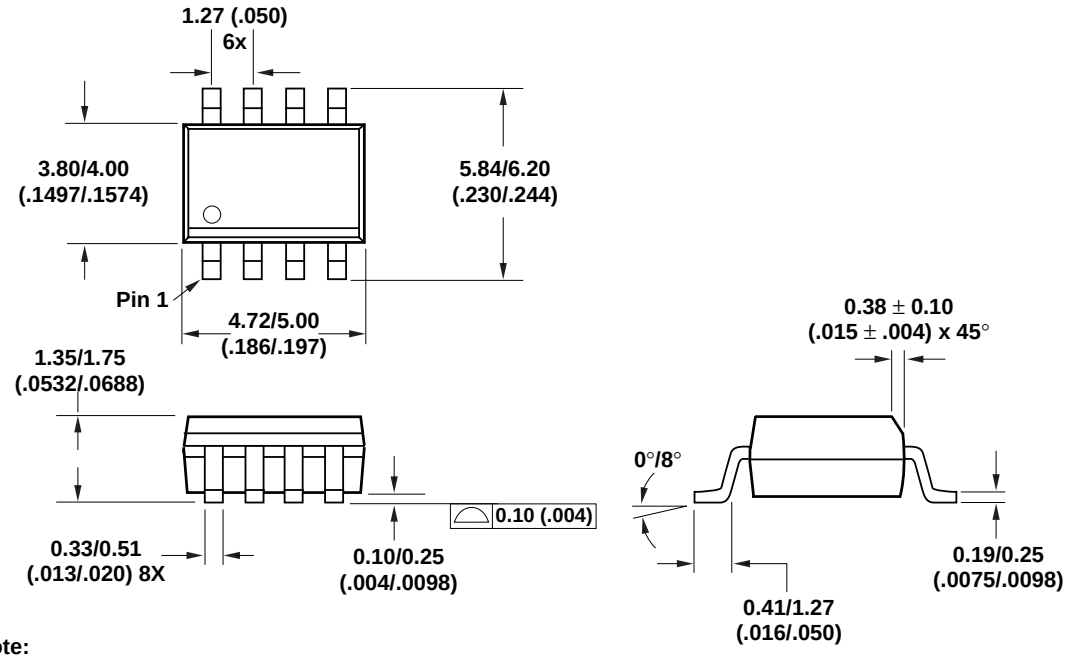


Part Number Ordering Information

Part Number	No. of Devices	Container
AT-36408-TR1	1000	7" Reel
AT-36408-BLK	25	Carrier Tape

Package Dimensions

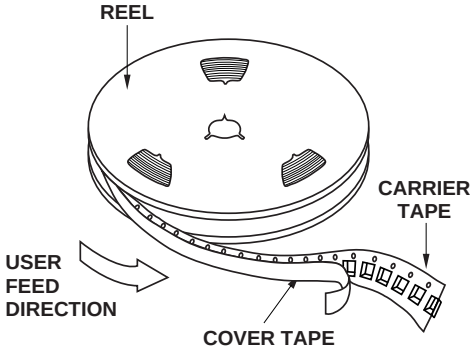
SOIC-8 Surface Mount Plastic Package

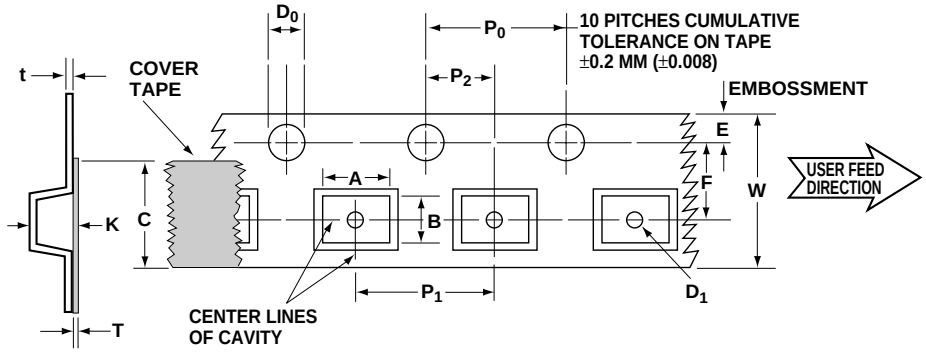


Note:

1. Dimensions are shown in millimeters (inches).

Tape Dimensions and Product Orientation For Package SOIC-8





DESCRIPTION		SYMBOL	SIZE (mm)	SIZE (INCHES)
CAVITY	LENGTH	A	6.45 ± 0.10	0.254 ± 0.004
	WIDTH	B	5.13 ± 0.10	0.202 ± 0.004
	DEPTH	K	2.11 ± 0.10	0.083 ± 0.004
	PITCH	P_1	8.00 ± 0.10	0.315 ± 0.004
	BOTTOM HOLE DIAMETER	D_1	1.50 min.	0.059 min.
PERFORATION	DIAMETER	D_0	1.50 + 0.10/-0	0.059 + 0.004/-0
	PITCH	P_0	4.00 ± 0.10	0.157 ± 0.004
	POSITION	E	1.75 ± 0.10	0.069 ± 0.004
CARRIER TAPE	WIDTH	W	8.00 ± 0.30	0.315 ± 0.012
	THICKNESS	t	0.255 ± 0.013	0.0100 ± 0.0005
COVER TAPE	WIDTH	C	9.19 ± 0.10	0.362 ± 0.004
	TAPE THICKNESS	T	0.051 ± 0.010	0.0020 ± 0.0004
DISTANCE BETWEEN CENTERLINE	CAVITY TO PERFORATION (WIDTH DIRECTION)	F	5.51 ± 0.05	0.217 ± 0.002
	CAVITY TO PERFORATION (LENGTH DIRECTION)	P_2	2.00 ± 0.05	0.079 ± 0.002