

**4.0W CLASS-G AUDIO AMPLIFIER WITH INTEGRATED BOOST CONVERTER AND BATTERY TRACKING AGC**

NEW PRODUCT

**Description**

The PAM8945 is a high efficiency Class-G audio power amplifier with an integrated boost converter. It drives up to 4.0W (10% THD+N) into a 4Ω speaker. With 85% typical efficiency, the PAM8945 helps extend battery life when playing audio.

The built-in boost converter generates the voltage rail for the output stage. This provides a louder audio output than a stand-alone amplifier connected directly to the battery. It also maintains a consistent loudness, regardless of battery voltage.

The PAM8945 features battery tracking AGC function which adjusts the amplifier gain to limit battery current at lower battery voltage.

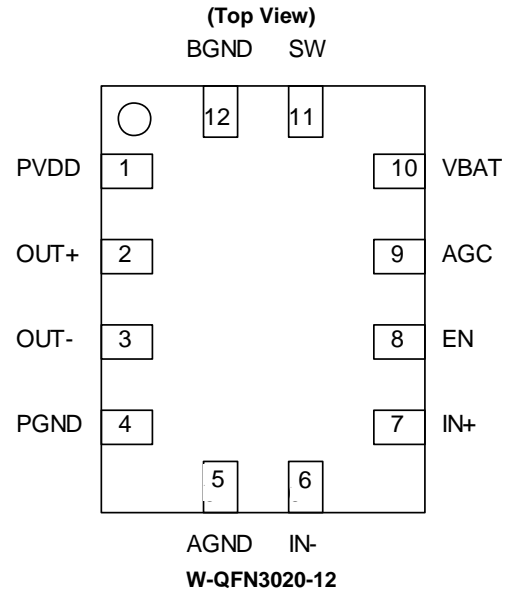
The PAM8945 features DC input protection and all outputs are fully protected against output-to-output shorts. The PAM8945 is available in tiny W-QFN3020-12 package.

**Features**

- Built-In Battery Tracking Automatic Gain Control (AGC)
- High Efficiency Integrated Boost Converter Over 85%
- 4.0W into a 4Ω Load at 10% THD
- 3.2W into a 4Ω Load at 1% THD
- Operates from 2.8V to 5.2V
- Efficient Class-G Prolongs Battery Life
- Minimized ON/OFF Pop Noise
- Superior Low Noise
- High PSRR
- DC Input Protection
- Auto-Recovery Short-Circuit Protection
- Thermal Shutdown
- Available in 2.0mm X 3.0mm 12L W-QFN Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Notes: 1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.  
 2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.  
 3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

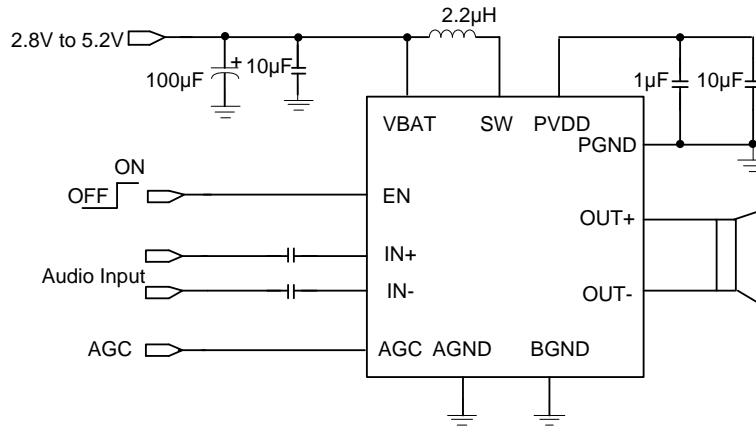
**Pin Assignments**



**Applications**

- Cell Phones
- PDA
- GPS
- Portable Electronics
- Speakers

**Typical Applications Circuit**

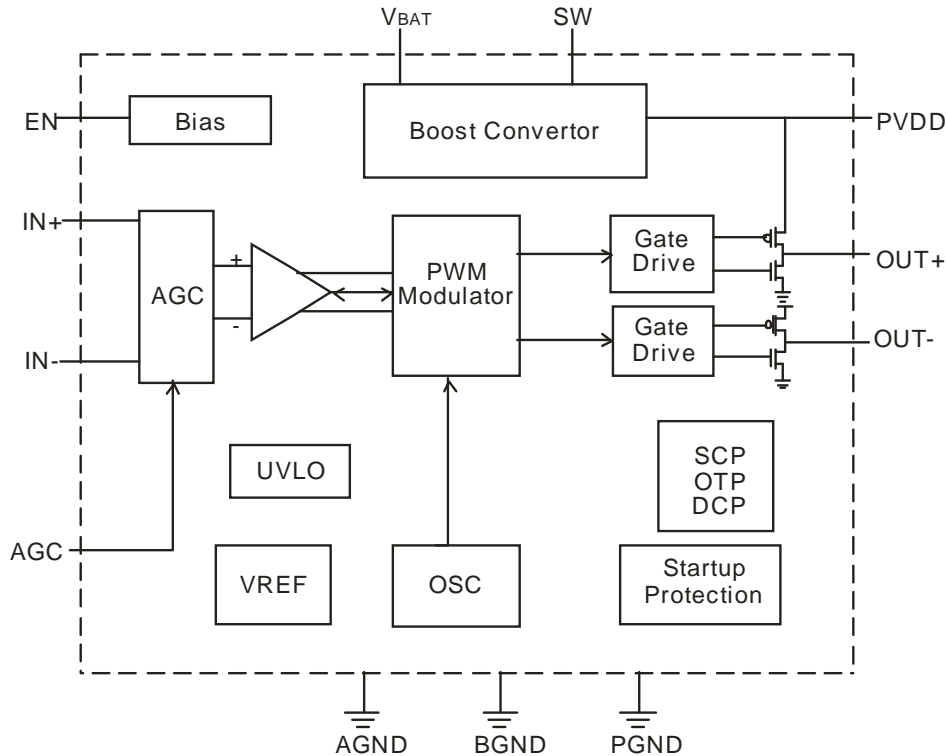


**Pin Descriptions**

Pin Number	Pin Name	Description
1	PVDD	Boost Converter Output and Amplifier Power Supply
2	OUT+	Amplifier Positive Audio Output
3	OUT-	Amplifier Negative Audio Output
4	PGND	Power Ground
5	AGND	Analog Ground
6	IN-	Negative Audio Input
7	IN+	Positive Audio Input
8	EN	Shutdown Terminal for the Chip
9	AGC	AGC Setting Gain
10	VBAT	Supply Voltage
11	SW	Boost Converter Switching
12	BGND	Power Ground

NEW PRODUCT

**Functional Block Diagram**



NEW PRODUCT

**Absolute Maximum Ratings** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Symbol	Parameter	Value	Unit
V <sub>BAT</sub>	Supply Voltage	-0.3 to 6.0	V
V <sub>I</sub>	Input Voltage, EN, IN+, IN-, AGC	-0.3 to V <sub>BAT</sub> + 0.3	V
T <sub>A</sub>	Operating Free-air Temperature Range	-40 to +85	°C
T <sub>J</sub>	Operating Junction Temperature Range	-40 to +150	°C
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C

**Recommended Operating Conditions** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Symbol	Parameter	Min	Max	Unit
V <sub>BAT</sub>	Supply Voltage	2.8	5.2	V
V <sub>IH</sub>	High-Level Input Voltage	EN	V <sub>BAT</sub>	V
V <sub>IL</sub>	Low-Level Input Voltage	EN	0.6	V
T <sub>A</sub>	Operating Free-Air Temperature	-40	+85	°C

**Thermal Information**

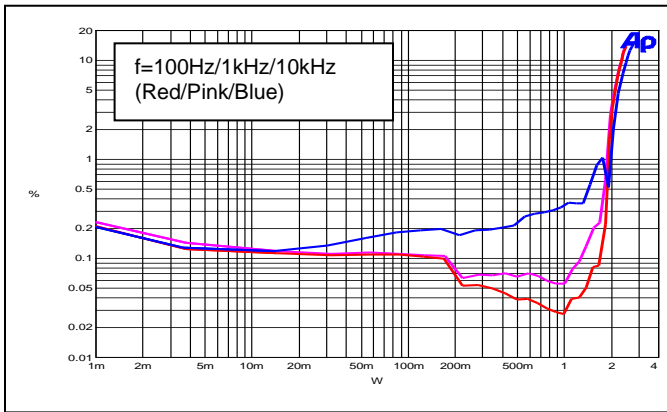
Symbol	Parameter	Package	Max	Unit
θ <sub>JA</sub>	Thermal Resistance (Junction to Ambient)	W-QFN3020-12	62	°C/W
θ <sub>Jc</sub>	Thermal Resistance (Junction to Case)	W-QFN3020-12	11	

**Electrical Characteristics** (@V<sub>BAT</sub>=3.6V, AGC=GND, T<sub>A</sub> = +25°C, R<sub>L</sub>=4Ω +33uH, unless otherwise specified.)

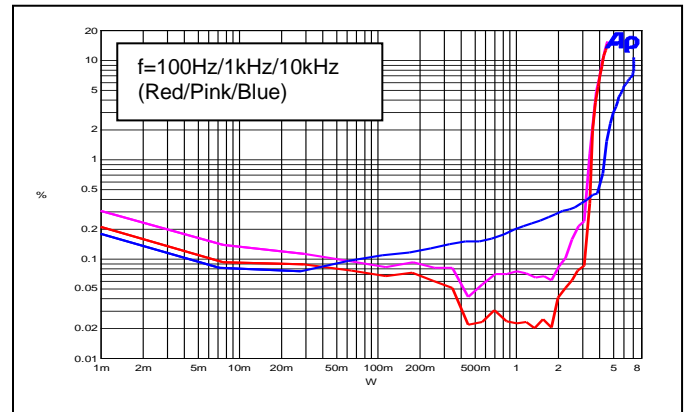
Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
V <sub>BAT</sub>	Supply Voltage	—		2.8	—	5.2	V
P <sub>O</sub>	Output Power	THD+N=10%, f=1kHz	V <sub>BAT</sub> =3.6V	—	4.0	—	W
		THD+N=1%, f=1kHz		—	3.2	—	W
THD+N	Total Harmonic Distortion Plus Noise	P <sub>O</sub> =1.0W, R <sub>L</sub> =8Ω	f=1kHz	—	0.07	—	%
		P <sub>O</sub> =2W, R <sub>L</sub> =4Ω		—	0.15	—	
PSRR	Power Supply Ripple Rejection	V <sub>BAT</sub> =3.6V, Input AC - ground with C=1μF	f=217Hz	—	70	—	dB
			f=1kHz	—	70	—	
			f=10kHz	—	67	—	
SNR	Signal-To-Noise Ratio	A-weighting	THD+N=1%	—	95	—	dB
V <sub>OP</sub>	Peak Output Voltage	V <sub>BAT</sub> =3.6V	f=1kHz	—	5.75	—	V
V <sub>O_TH</sub>	Boost Convertor Auto-Pass Through Threshold	—	—	—	2	—	V(Peak)
V <sub>N</sub>	Output Noise	Input AC-ground	No A-weighting	—	100	—	μV
			A-weighting	—	60	—	
η	Efficiency	R <sub>L</sub> =8Ω, P <sub>O</sub> =1W	f=1kHz	—	86	—	%
I <sub>Q</sub>	Quiescent Current	V <sub>BAT</sub> =3.6V	No Load	—	4	—	mA
I <sub>SD</sub>	Shutdown Current	V <sub>BAT</sub> =2.8V to 5.2V	EN=0V	—	—	1	μA
R <sub>DS(ON)</sub>	Static Drain-to-Source On-State Resistor	High Side PMOS, I=500mA	V <sub>BAT</sub> =5V	—	260	—	mΩ
		Low Side NMOS, I=500mA	V <sub>BAT</sub> =5V	—	160	—	mΩ
f <sub>SW</sub>	Switching Frequency	V <sub>BAT</sub> =2.8V to 5.2V	Boost	—	1200	—	kHz
			Class D	—	300	—	
G <sub>V</sub>	Closed-Loop Gain	—	—	—	20	—	dB
R <sub>IN</sub>	Input Impedance	A <sub>V</sub> =20dB	—	—	24	—	KΩ
V <sub>OS</sub>	Output Offset Voltage	Input AC-ground	—	—	—	20	mV
I <sub>PEAK</sub>	Convertor SW Peak Current	V <sub>BAT</sub> =3.6V	—	—	4	—	A
t <sub>ON</sub>	Start-Up Time From EN	—	—	—	6	—	ms
V <sub>IH</sub>	En Input High Voltage	V <sub>BAT</sub> =5V	—	1.3	—	—	V
V <sub>IL</sub>	En Input Low Voltage	V <sub>BAT</sub> =5V	—	—	—	0.6	

**Performance Characteristics** (@ $V_{BAT}=3.6V$ ,  $AGC=GND$ ,  $T_A = +25^\circ C$ ,  $R_L=8\Omega +33\mu H$ , unless otherwise specified.)

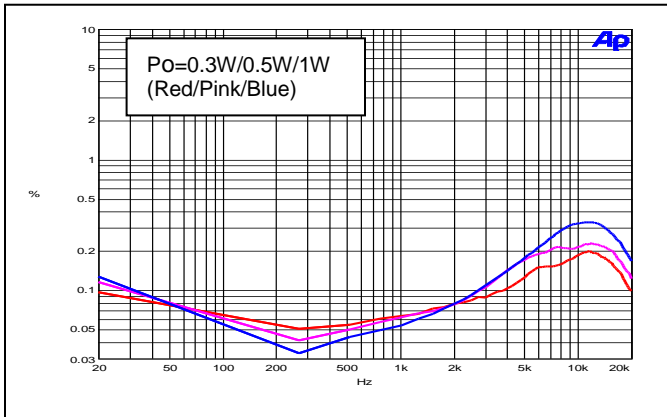
**THD+N vs. Output Power ( $R_L = 8\Omega$ )**



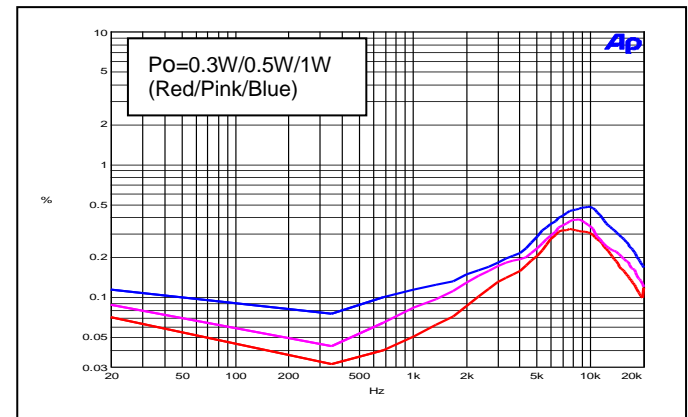
**THD+N vs. Output Power ( $R_L = 4\Omega$ )**



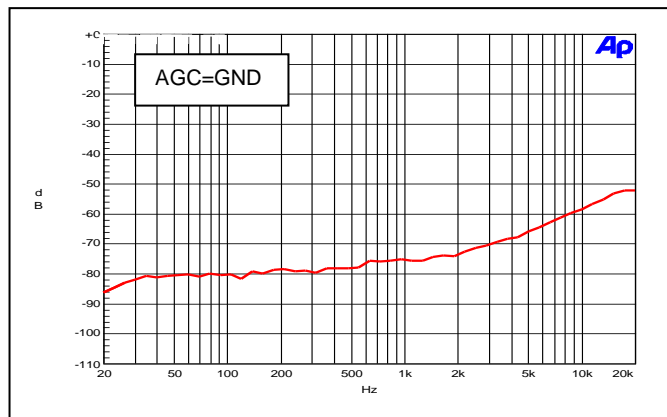
**THD+N vs. Frequency ( $R_L = 8\Omega$ )**



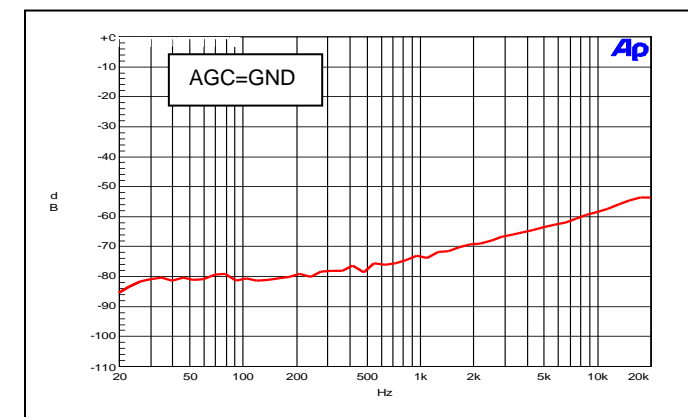
**THD+N vs. Frequency ( $R_L = 4\Omega$ )**



**PSRR vs. Frequency ( $R_L = 8\Omega$ )**



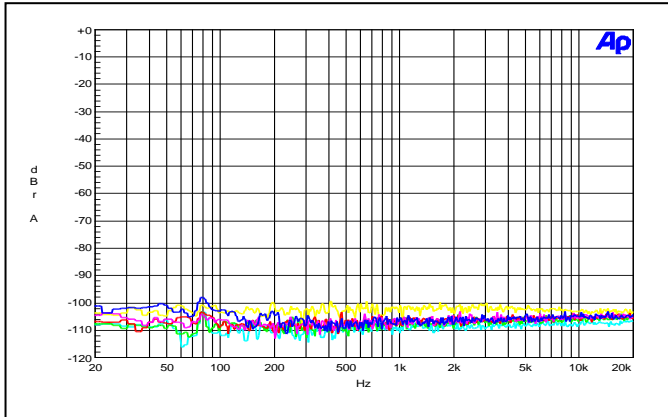
**PSRR vs. Frequency ( $R_L = 4\Omega$ )**



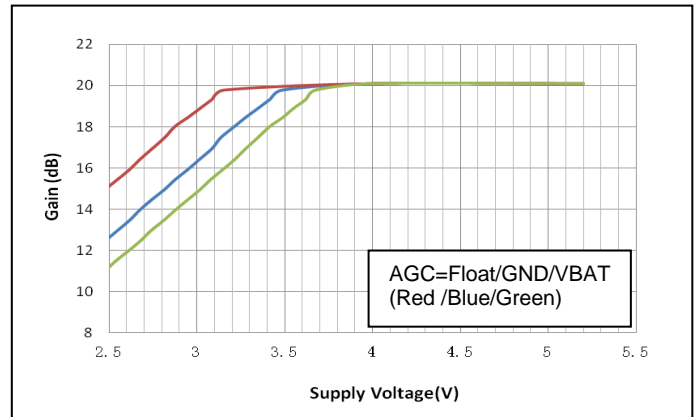
NEW PRODUCT

**Performance Characteristics** (@V<sub>BAT</sub>=3.6V, AGC=GND, T<sub>A</sub> = +25°C, R<sub>L</sub>=8Ω +33μH, unless otherwise specified.)

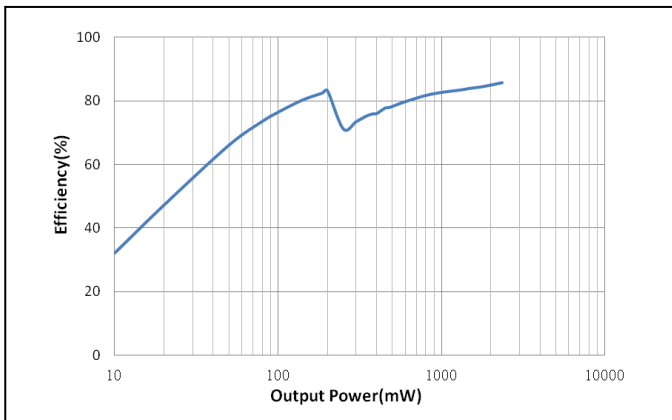
**Noise Floor (R<sub>L</sub> =8Ω)**



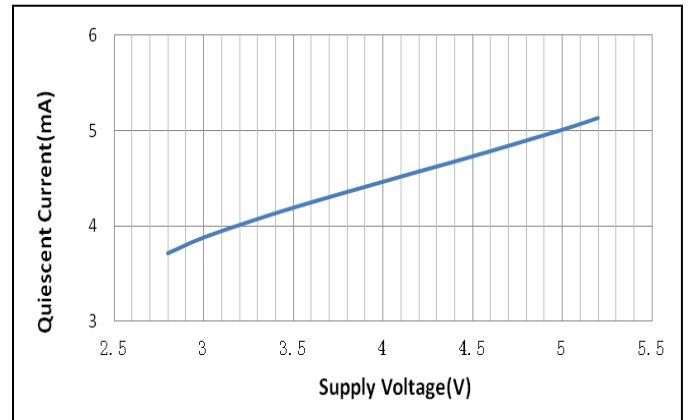
**Gain vs. Supply Voltage**



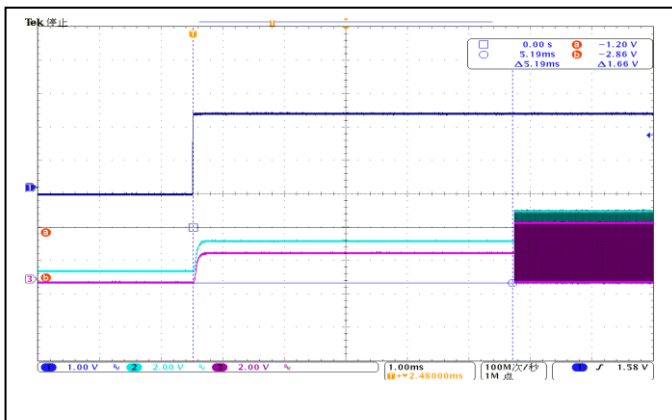
**Efficiency vs. Output Power (R<sub>L</sub> =8Ω)**



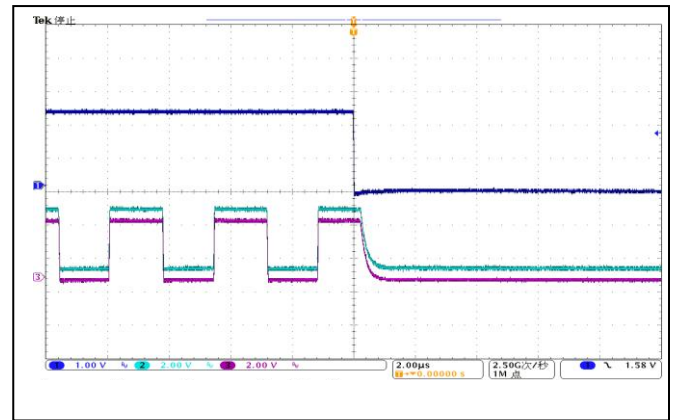
**Quiescent Current vs. Supply Voltage**



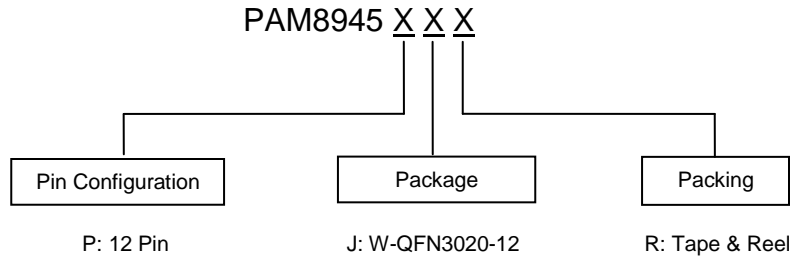
**Start Up**



**Shutdown**



**Ordering Information** (Note 4)



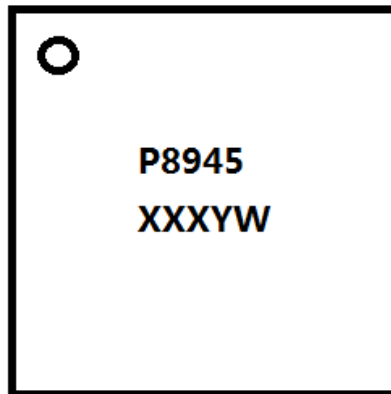
Part Number	Package	7" Tape and Reel	
		Quantity	Part Number Suffix
PAM8945PJR	W-QFN3020-12	3000/Tape & Reel	-7

Note: 4. For packaging details, go to our website at <http://www.diodes.com/products/packages.html>.

**Marking Information**

W-QFN3020-12

(Top View)

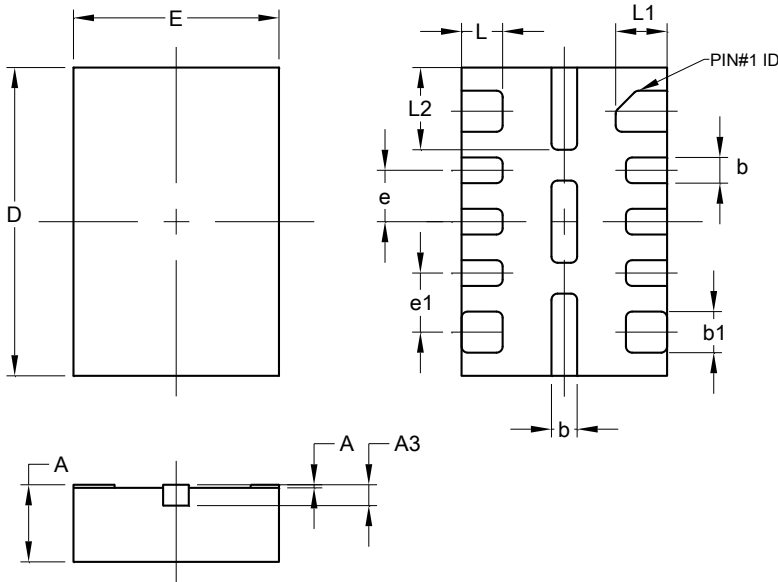


P8945: Product Code  
 X: Internal Code  
 Y: Year 0~9  
 W: Week: A~Z: 1~26 weeks;  
 a~z: 27~52 weeks; z  
 represents 52 and 53 weeks.

**Package Outline Dimensions**

Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.

**W-QFN3020-12**

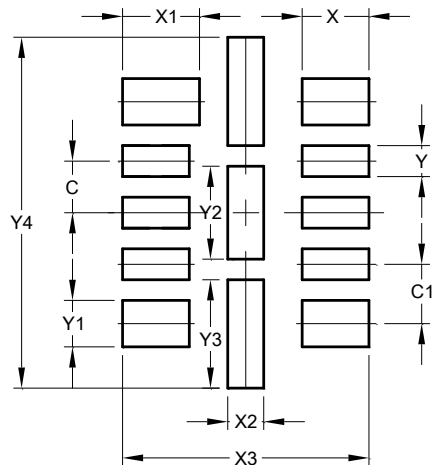


W-QFN3020-12			
Dim	Min	Max	Typ
A	0.700	0.800	-
A1	0	0.05	-
A3	0.203REF		
b	0.200	0.300	-
b1	0.350	0.450	-
D	1.900	2.100	2.000
E	2.900	3.100	3.000
e	-	-	0.500
e1	-	-	0.575
L	0.350	0.450	-
L1	0.450	0.550	-
L2	0.750	0.850	-
All Dimensions in mm			

**Suggested Pad Layout**

Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

**W-QFN3020-12**



Dimensions	Value (in mm)
C	0.500
G	0.575
X	0.650
X1	0.750
X2	0.350
X3	2.400
Y	0.300
Y1	0.450
Y2	0.900
Y3	1.050
Y4	3.400



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