Analogwin

High Voltage, Low Noise, Zero-Drift Operational Amplifier

AWS8611

FEATURES

- Supply Voltage Range: 4.5V to 60V
- Offset Voltage: 4μV (Max.)
- Offset Voltage Drift: 30nV/°C
- Input Noise Voltage:
  290nVP-P, 0.1 to 10Hz (Typ.)
  17nV/√Hz, 1kHz (Typ.)
- Input Common Mode Range: V- to V+-1.5V
- Rail-to-Rail Output
- Gain Bandwidth Product:1.5MHz (Typ.)
- Slew Rate: 2.0V/μs (Typ.)
- AVOL: 150dB (Typ.)
- PSRR: 160dB (Typ.)
- CMRR: 150dB (Typ.)
- Shutdown Mode

APPLICATIONS

- High Resolution Data Acquisition
- Reference Buffer
- Electronic Scales
- Low-side Current Sense
- Automotive Monitors and Control

GENERAL DESCRIPTION

The AWS8611 is a high voltage, low noise, zero-drift operational amplifier that provides excellent DC performance over a wide input supply voltage range of 4.5 to 60V. A maximum offset voltage of 4μV and a DC to 10Hz input noise voltage of 290nVP-P are achieved by suppressing the offset voltage and 1/f noise. The AWS8611 also benefits from a self-calibrating circuity, which provides low offset voltage drift with temperature, 30nV/°C (Max.), and zero-drift over time. The amplifier also features an excellent power supply rejection ratio (PSRR) of 160dB and a common mode rejection ratio (CMRR) of 150dB.

The AWS8611 offers a rail-to-rail output swing and an input common mode range of V- to V+-1.5V. In addition, AWS8611 features a gain bandwidth product of 1.5MHz (Typ.) and a slew rate of 2.0V/μs (Typ.).

With wide supply range, low noise, low offset voltage and excellent PSRR and CMRR performance, AWS8611 is well suited in dynamic range test, high resolution measurement, and instrumentation systems.

TYPICAL APPLICATION

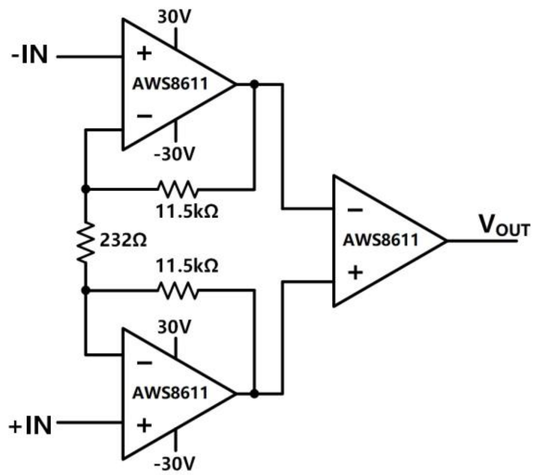

Figure 1. Typical Application Circuit

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PIN CONFIGURATION

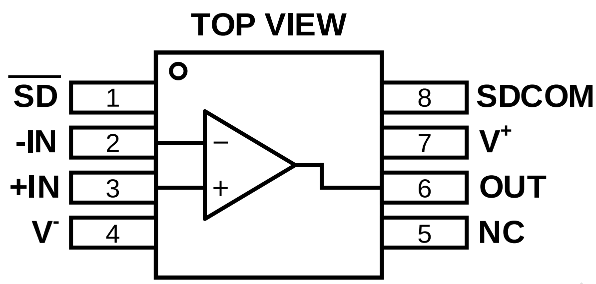


Figure 2. MSOP8L package (TOP VIEW; NOT TO SCALE)

Table 1. Pin Function Descriptions

Pin No.	Pin Name	Type[1]	Description
1	$\overline{SD}$	I	Shutdown Control Pin
2	-IN	I	Inverting Input
3	+IN	I	Non-Inverting Input
4	V^-	P	Negative Power Supply
5	NC	-	No Internal Connection
6	OUT	O	Amplifier Output
7	V^+	P	Positive Power Supply
8	SDCOM	I	Reference Voltage for $\overline{SD}$

1 Legend:
A = Analog Pin
P = Power Pin
D = Digital Pin
I = Input Pin
O = Output Pin

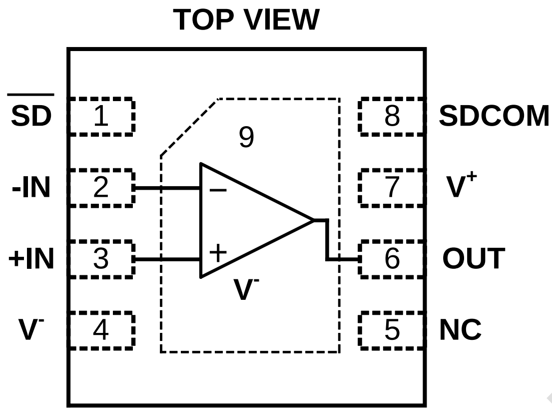


*Figure 3. DFN3*3-8L package with exposed thermal pad (TOP VIEW; NOT TO SCALE)*

Table 2. Pin Function Descriptions

Pin No.	Pin Name	Type[1]	Description
1	$\overline{SD}$	I	Shutdown Control Pin
2	-IN	I	Inverting Input
3	+IN	I	Non-Inverting Input
4	V-	P	Negative Power Supply
5	NC	-	No Internal Connection
6	OUT	O	Amplifier Output
7	V+	P	Positive Power Supply
8	SDCOM	I	Reference Voltage for $\overline{SD}$
9	V-	P	Negative Power Supply

1 Legend:
A = Analog Pin
P = Power Pin
D = Digital Pin
I = Input Pin
O = Output Pin

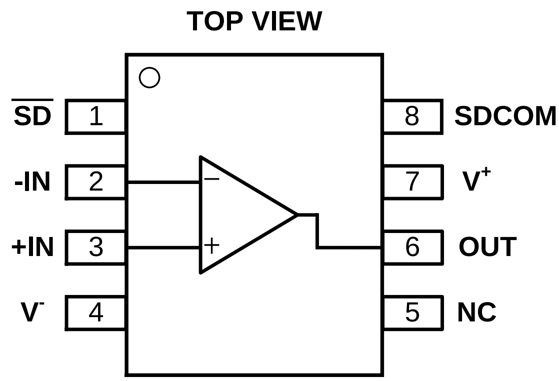


Figure 4. SOP8L package (TOP VIEW; NOT TO SCALE)

Table 3. Pin Function Descriptions

Pin No.	Pin Name	Type[1]	Description
1	$\overline{SD}$	I	Shutdown Control Pin
2	-IN	I	Inverting Input
3	+IN	I	Non-Inverting Input
4	V-	P	Negative Power Supply
5	NC	-	No Internal Connection
6	OUT	O	Amplifier Output
7	V+	P	Positive Power Supply
8	SDCOM	I	Reference Voltage for $\overline{SD}$

1 Legend:
A = Analog Pin
P = Power Pin
D = Digital Pin
I = Input Pin
O = Output Pin

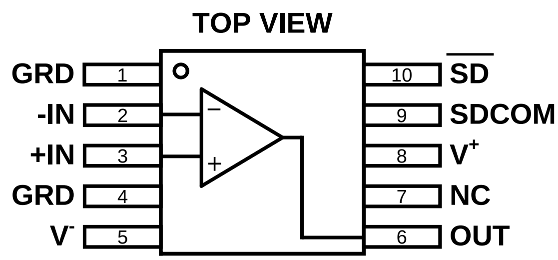


Figure 5. MSOP10L package (TOP VIEW; NOT TO SCALE)

Table 4. Pin Function Descriptions

Pin No.	Pin Name	Type[1]	Description
1	GRD	-	Guard Ring. No Internal Connection
2	-IN	I	Inverting Input
3	+IN	I	Non-Inverting Input
4	GRD	-	Guard Ring. No Internal Connection
5	V-	P	Negative Power Supply
6	OUT	O	Amplifier Output
7	NC	-	No Internal Connection
8	V+	P	Positive Power Supply
9	SDCOM	I	Reference Voltage for $\overline{SD}$
10	$\overline{SD}$	I	Shutdown Control Pin

1 Legend:
A = Analog Pin
P = Power Pin
D = Digital Pin
I = Input Pin
O = Output Pin

SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Table 5.

Parameter	Min	Max	Unit
Supply Voltage (V^+ to V^-)		60	V
Input Voltage (-IN, +IN)	V^--0.3	V^++0.3	V
Input Voltage ($\overline{SD}$, SDCOM)	V^--0.3	V^++0.3	V
Differential Input Voltage (-IN-+IN)	-6	6	V
Differential Input Voltage (($\overline{SD}$ – SDCOM)	-0.3	5.3	V
Output Short Circuit Duration	Indefinite		
Junction temperature	−40	150	°C
Storage temperature	−55	150	°C
Lead temperature (soldering, 10sec.)		260	°C

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

RECOMMENDED OPERATING CONDITIONS

Table 6.

Parameters	Min	Typ	Max	Unit
Operating Temperature	−40		125	°C
Continuous Supply Voltage (V_{IN})	4.5		60	V
Junction Temperature (T_J)	−40		125	°C

ELECTROSTATIC DISCHARGE (ESD)

Table 7. ESD Rating

Parameters	Description	Rating	Unit
HBM	Human Body Model ANSI/ESDA/JEDEC JS-001-2014 Classification, Class: 2	±2000	V
CDM	Charged Device Mode ANSI/ESDA/JEDEC JS-002-2014 Classification, Class: C0b	±500	V

THERMAL RESISTANCE

Thermal performance is directly linked to printed circuit board (PCB) design and operating environment. Close attention to PCB thermal design is required.

Table 8. Thermal Resistance

Item[1,2]	Description	Value	Unit
θ_{JA}	Junction-to-ambient thermal resistance	TBD	°C/W
θ_{JC_Top}	Junction-to-case (top) thermal resistance	TBD	°C/W

1 The package thermal impedance is calculated in accordance to JESD 51-7.
2 Thermal Resistances were simulated on a 4-layer, JEDEC board.

ESD CAUTION

Electrostatic Discharge Sensitive Device.

Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

ELECTRICAL SPECIFICATIONS

At T_A = 25°C, V_S = ±2.25V to ±30V for AWS8611, R_L=10kΩ, unless otherwise specified.
All min and max specifications are at T_A = -40°C to 125°C.

Table 9.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
POWER SUPPLY						
Supply Voltage Range	V_S		4.5		60	V
Operating Quiescent Current	I_Q			1.1	2	mA
Shutdown Supply Current	I_{SHDN}	VS = ±2.25V		3	6	μA
		VS = ±15V		5.5	10	
		VS = ±30V		6.5	12	
Shutdown Threshold ($\overline{SD}$ – SDCOM) Low	V_{SDL}		0.7			V
Shutdown Threshold ($\overline{SD}$ – SDCOM) High	V_{SDH}				1.7	V
SDCOM Voltage Range	V_{SD}		V^-		V^+ - 2	V
$\overline{SD}$ Pin Current	I_{SD}		-2	-0.6		μA
SDCOM Pin Current	I_{SDCOM}			2.5	6.5	μA
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{OS}	@T_A=25°C		1	4	μV
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$				0.03	μV/ΔC
Input Bias Current	I_B	-40°C to 125°C		30	6000	pA
Input Offset Current	I_{OS}	-40°C to 125°C		60	1500	pA
Power Supply Rejection Ratio	PSRR		135	160		dB
		V_S = ±2.25V	115	145		
Common Mode Rejection Ratio	CMRR	V_S = ±15V	130	150		dB
		V_S = ±30V	135	150		
		V_S = ±2.25V	120	150		
Open Loop Voltage Gain	AVOL	V_S = ±15V	130	155		dB
		V_S = ±30V	135	155		
Input Capacitance(1)	C_{IN}			13.5		pF
OUTPUT CHARACTERISTICS						
Output Voltage Swing Low	$V_{OL}-V^-$	No Load		0.2	15	mV
		I_{SINK} =1mA		28	90	
		I_{SINK} =5mA		140	400	
Output Voltage Swing High	V^+-V_{OH}	No Load		1.1	15	mV

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
Output Voltage Swing High	V^+-V_{OH}	I_{SOURCE} =1mA		40.5	120	mV
Output Voltage Swing High	V^+-V_{OH}	I_{SOURCE} =5mA		210	550	mV
Short Circuit Source Current	I_{SCSINK}	V_S=±2.25V		20	35	mA
		V_S=±15V		20	38	mA
		V_S=±30V		20	38	
Short Circuit Sink Current	$I_{SCSOURECE}$	V_S=±2.25V	-35	-22		mA
		V_S=±15V	-38	-24		
		V_S=±30V	-38	-24		
AC SPECIFICATIONS						
Gain Bandwidth Product	GBW			1.5		MHz
Rising Slew Rate	SR_{RISE}	A_V=-1, R_L=10kΩ, V_S=±2.25V		3.5	7.0	V/μs
		A_V=-1, R_L=10kΩ, V_S=±15V		3.2	7.0	
		A_V=-1, R_L=10kΩ, V_S=±30V		3.2	7.0	
Falling Slew Rate	SR_{FALL}	A_V=-1, R_L=10kΩ, V_S=±2.25V		2.2	5.0	V/μs
		A_V=-1, R_L=10kΩ, V_S=±15V		2.3	5.0	
		A_V=-1, R_L=10kΩ, V_S=±30V		2.3	5.0	
Rising Overload Recovery Time	ORT_{RISE}	A_V=10, R_L=2kΩ, C_L=100pF		2.0		μs
Falling Overload Recovery Time	ORT_{FALL}	A_V=10, R_L=2kΩ, C_L=100pF		3.0		μs
NOISE PERFORMANCE						
Noise Current Spectral Density	i_n	@1kHz		275		fA/√Hz
Noise Voltage Spectral Density	e_n	@1kHz		17		nV/√Hz
Input Noise Voltage	e_{Np-p}	0.1 to 10Hz		290		nV/V_{P-P}
Total Harmonic Distortion and Noise	THD+N	f = 1kHz, G =1, R_L = 10kΩ, V_{OUT} = $9V_{RMS}$		0.003 6		‰

TYPICAL PERFORMANCE CHARACTERISTICS

V_S = ±30V for AWS8611, R_L=10kΩ, at T_A = 25℃ unless otherwise specified.

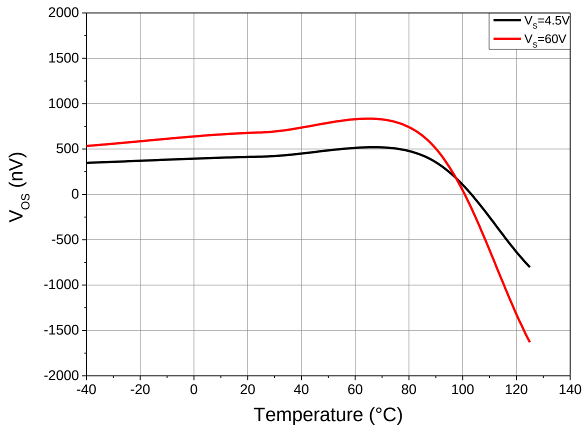


Figure 6. V_{OS} vs. Temperature

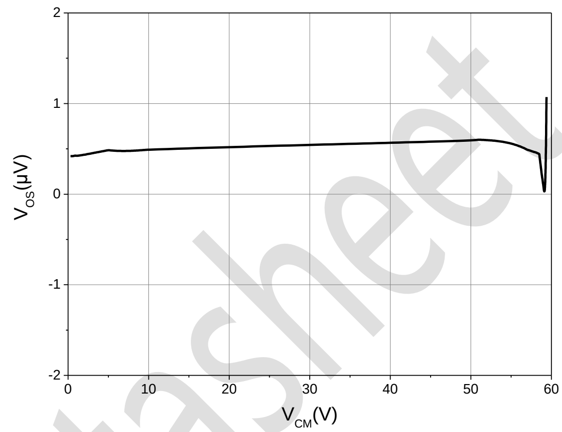


Figure 7. V_{OS} vs. Common Mode Voltage

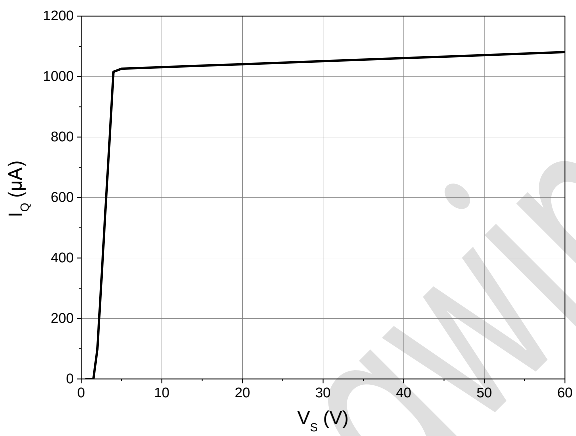


Figure 8. Quiescent Current vs. Supply Voltage

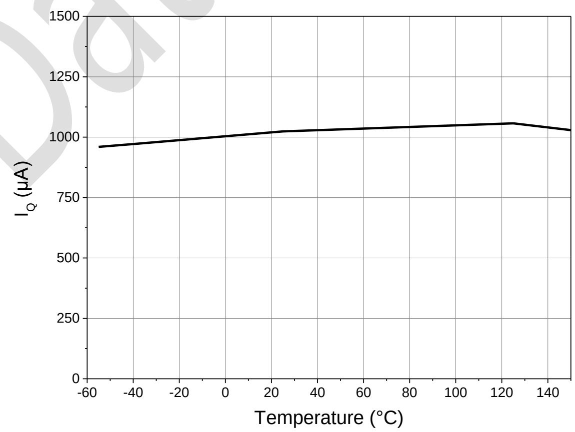


Figure 9. Quiescent Current vs. Temperature

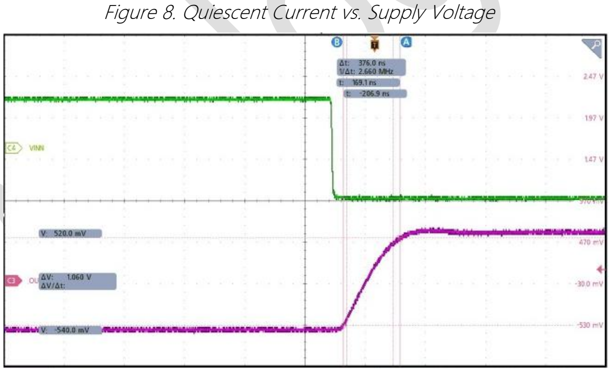


Figure 10. Rising Slew Rate

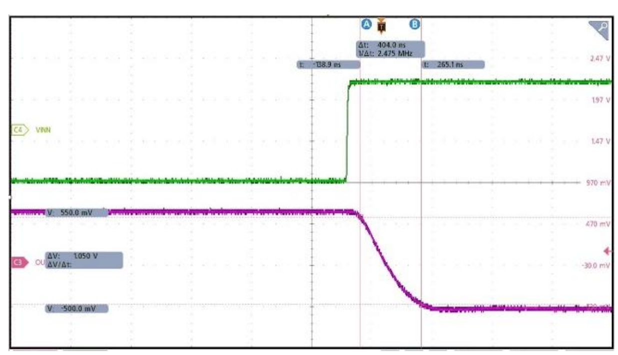


Figure 11. Falling Slew Rate

V_S = ±30V for AWS8611, R_L=10kΩ, at T_A = 25℃ unless otherwise specified.

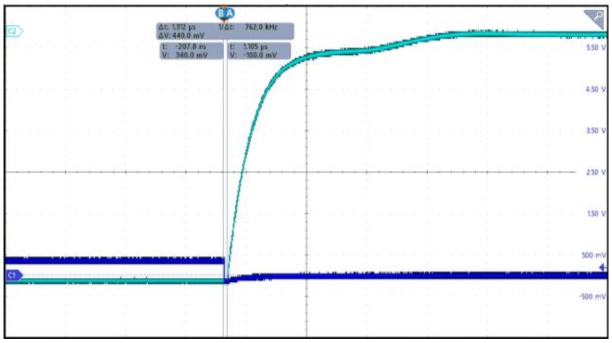


Figure 12. Rising Overload Recovery Time

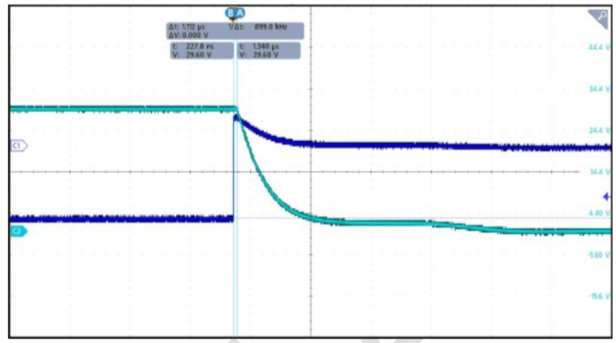


Figure 13. Falling Overload Recovery Time

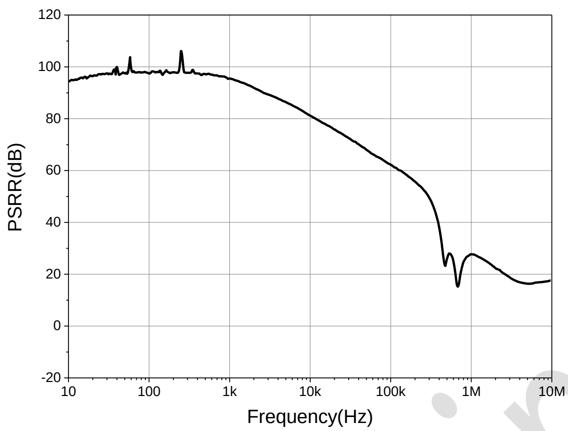


Figure 14. PSRR vs. Frequency

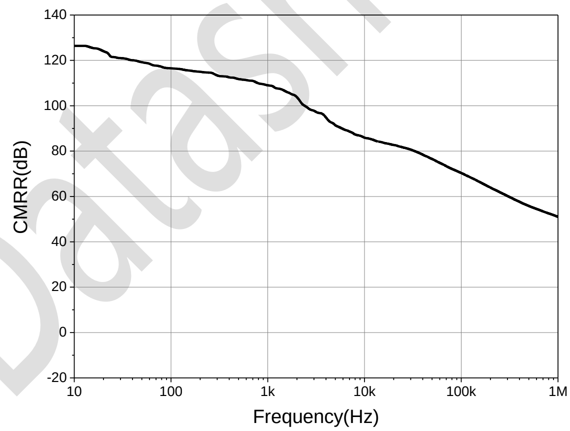


Figure 15. CMRR vs. Frequency

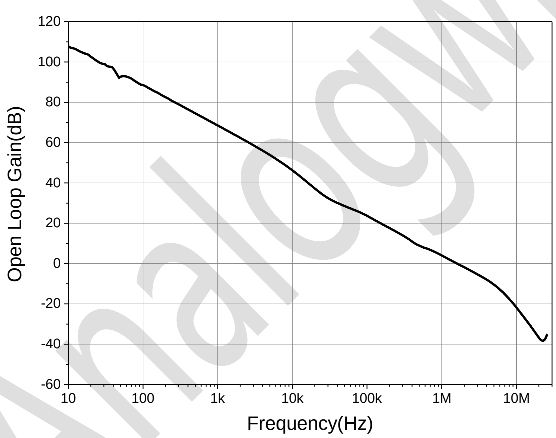


Figure 16. Open Loop Gain vs. Frequency

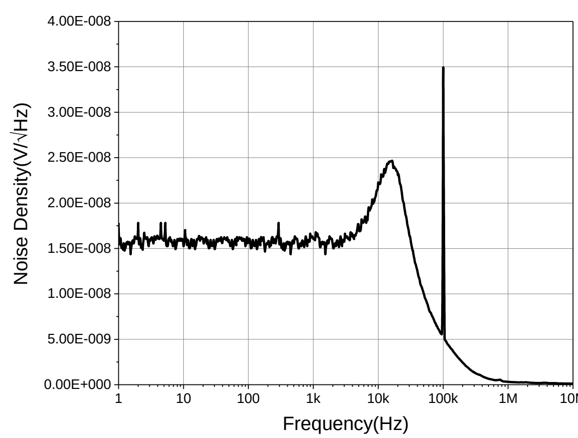


Figure 17. Voltage Noise Spectral Density vs. Frequency

V_S = ±30V for AWS8611, R_L=10kΩ, at T_A = 25℃ unless otherwise specified.

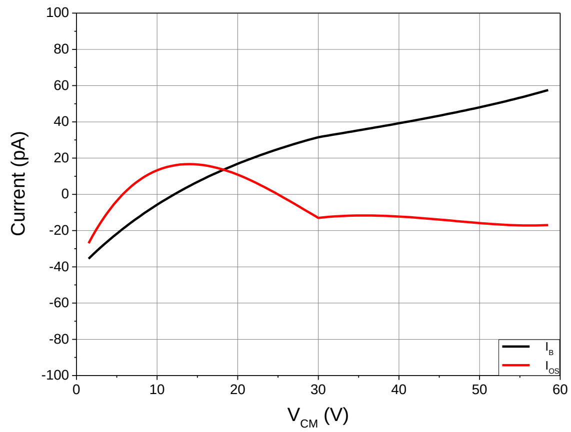


Figure 18. I_B or I_{OS} vs. Common Mode Voltage

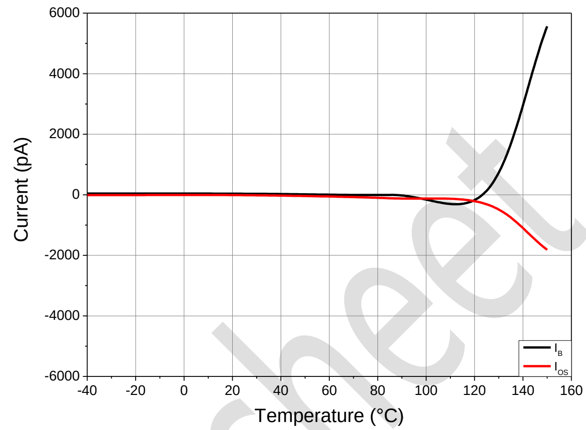


Figure 19. I_B or I_{OS} vs. Temperature

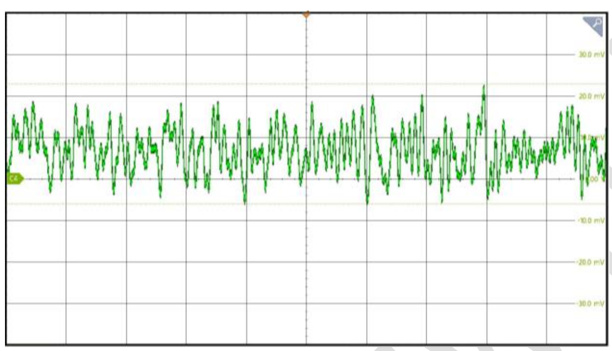


Figure 20. 0.1 to 10Hz Output Noise(Gain 10000)

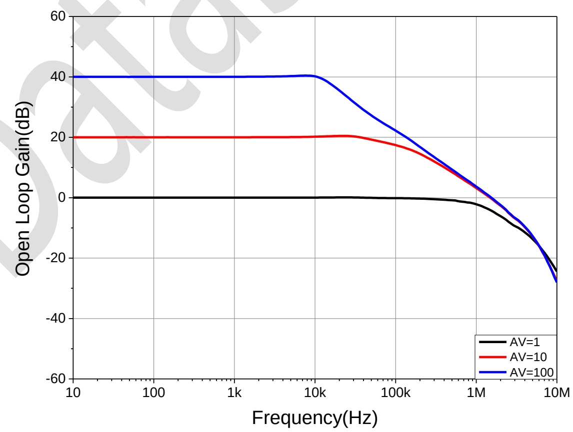


Figure 21. Close Loop Gain vs. Frequency

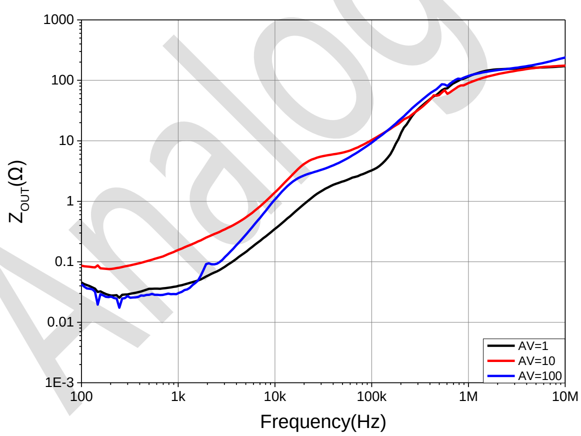


Figure 22. Output Impedance

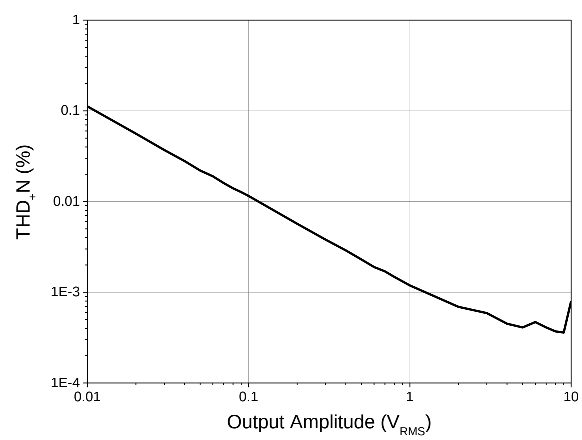


Figure 23. THD+N vs. Amplitude

V_S = ±30V for AWS8611, R_L=10kΩ, at T_A = 25℃ unless otherwise specified.

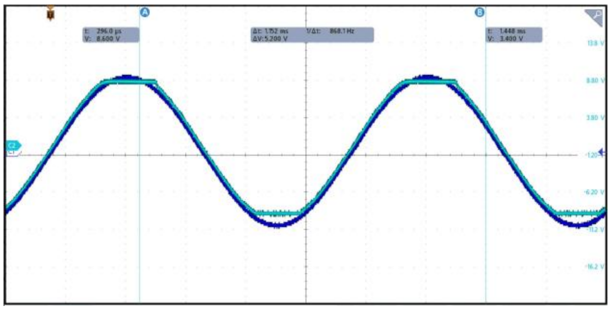


Figure 24. No Phase Reversal(AV = +1 VS = ±9V VIN = ±10V RIN = 1kΩ)

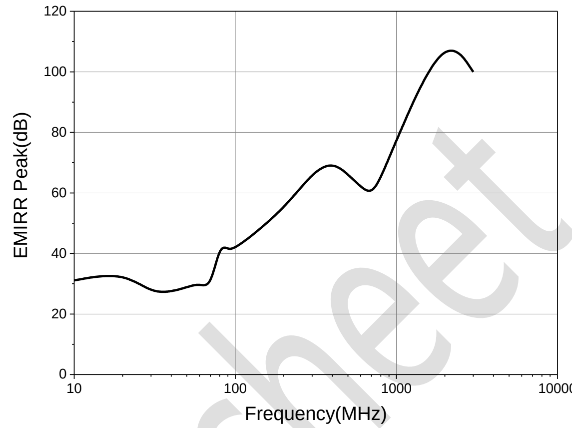


Figure 25. +IN EMIRR vs. Frequency(RF level of −20 dBVP)

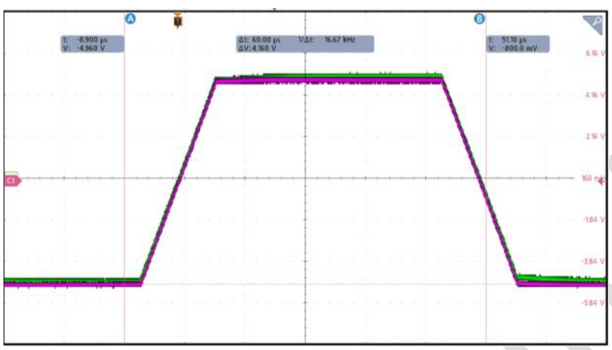


Figure 26. Large Signal Response
(VS = ±30V VIN = ±10V AV = +1 CL = 200pF)

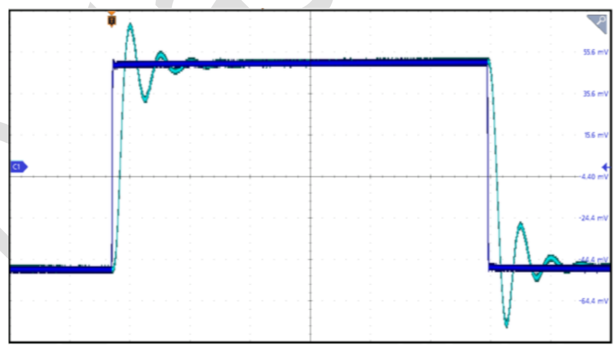


Figure 27. Small Signal Response
(VS = ±30V VIN = ±0.5V AV = +1 CL = 200pF)

PACKAGE INFORMAGION

PACKAGE TOP MARKING

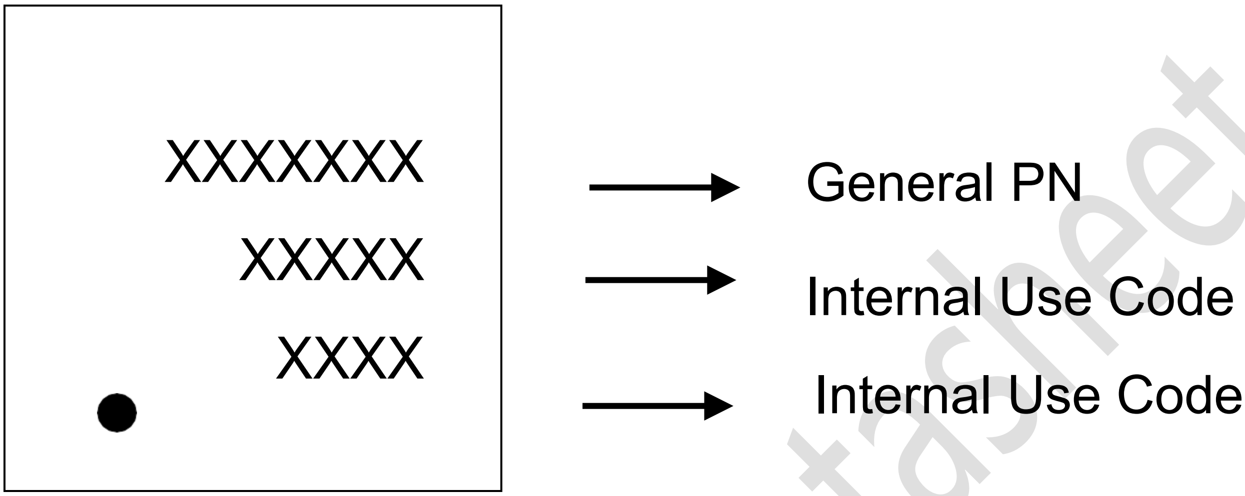


Figure 28. Package Top Marking

TAPE AND REEL BOX INFORMATION

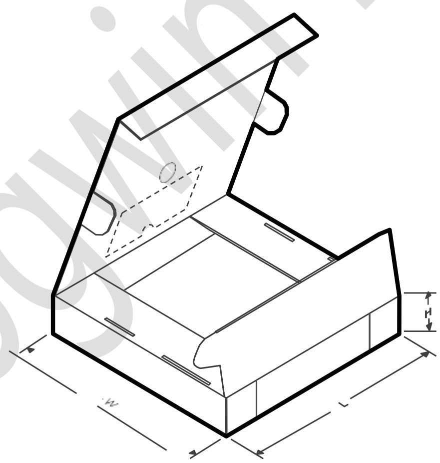


Figure 29. Tape and Reel Box Information

Device	PACKAGE TYPE	PACKAGE DRAWING	PINS	SPQ	LENG	PINS	SPQ
AWK8611DFR	DFN8L	DF	8	3000	336.0	336.0	48.0
AWS8611EAR	MSOP8L	EA	8	5000	336.0	336.0	48.0
AWS8611EBR	MSOP10L	EB	10	5000	336.0	336.0	48.0
AWS8611AAR	SOP8L	AA	8	4000	336.0	336.0	48.0

TAPE AND REEL INFORMATION

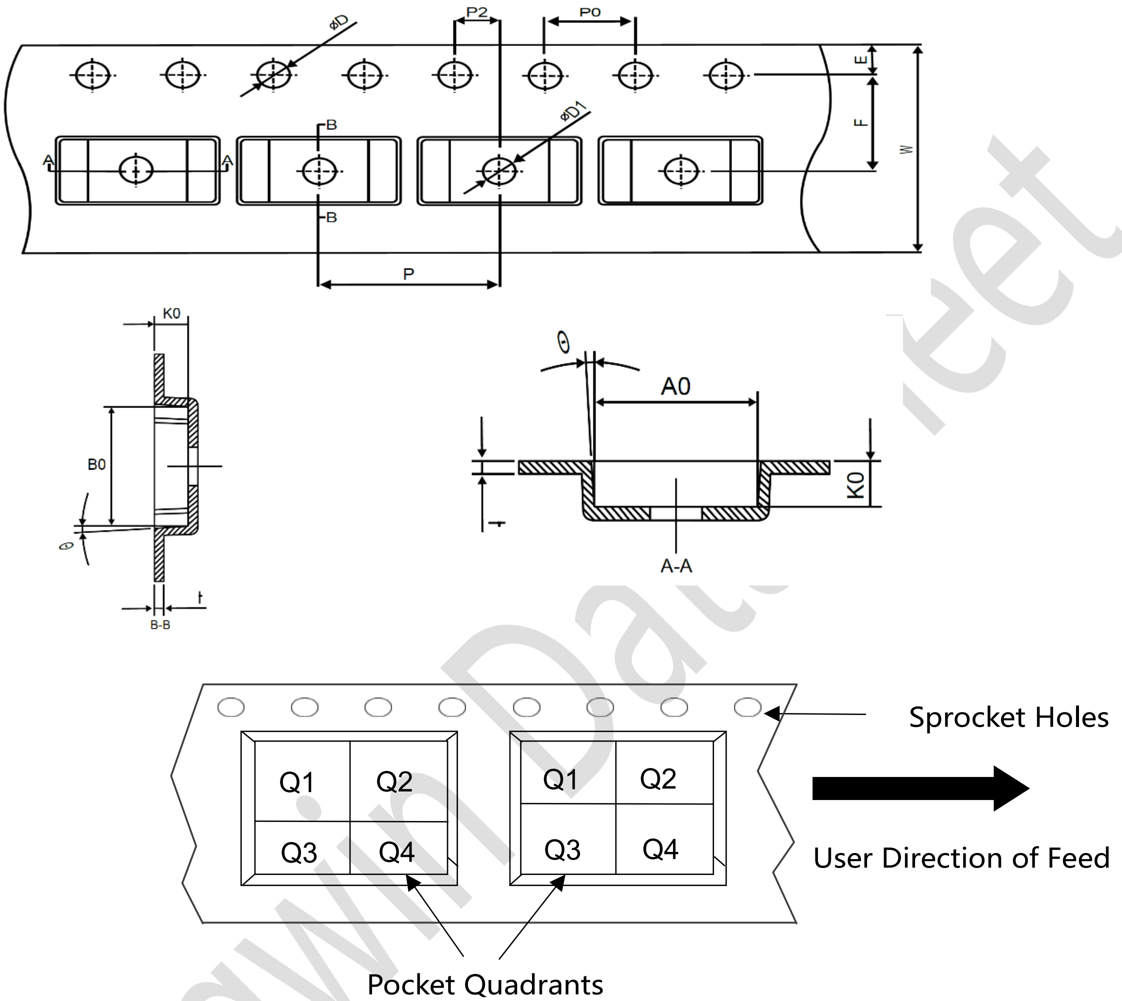


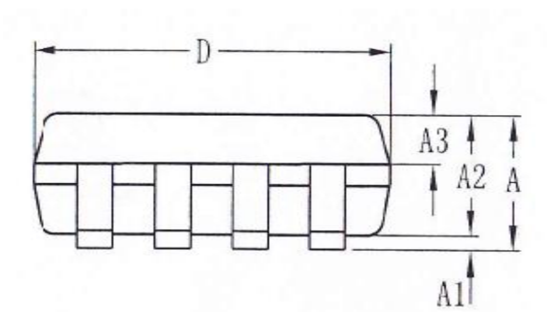
Figure 30. TAPE and Reel Information

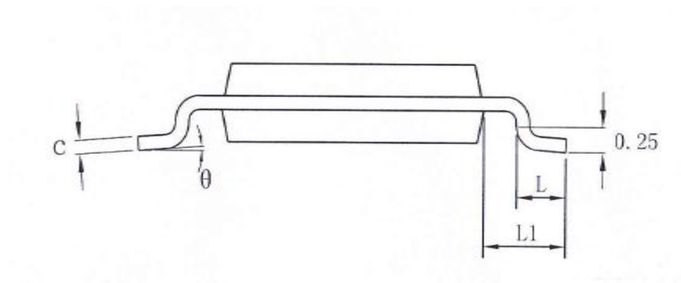
DIMENSIONS AND PIN1 ORIENTATION

Device	PACKAGE TYPE	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P (mm)	P0 (mm)	W (mm)	Pin1 Quadrant	Quantity
AWS8611DFR	DFN8L	12.40	3.30	3.30	1.10	8.00	4.00	12.00	Q1	3000
AWS8611EAR	MSOP8L	12.40	5.40	3.40	1.40	8.00	4.00	12.00	Q1	5000
AWS8611EBR	MSOP10L	12.40	5.40	3.40	1.40	8.00	4.00	12.00	Q1	5000
AWS8611AAR	SOP8L	12.40	6.55	5.30	2.0	8.00	4.00	12.00	Q1	4000

All dimensions are nominal

PACKAGE OUTLINES





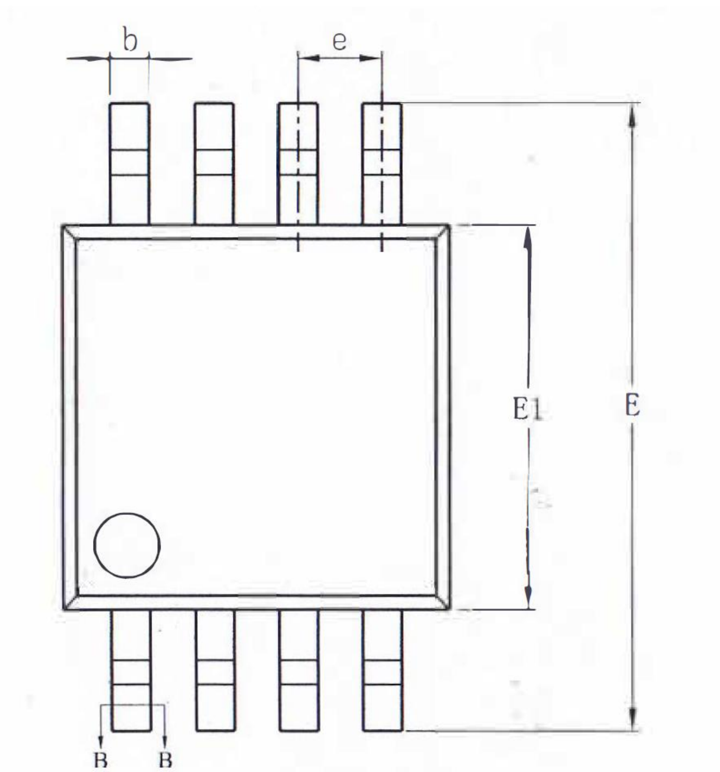


Figure 31. MSOP8L PKG POD

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	–	–	1.10
A1	0.05	–	0.15
A2	0.75	0.85	0.95
A3	0.3	0.35	0.40
b	0.28	–	0.36
c	0.15	–	0.19
D	2.90	3.00	3.10
e	0.65BSC		
L1	0.95REF		
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
L	0.30	0.40	0.50
θ	0	–	8°

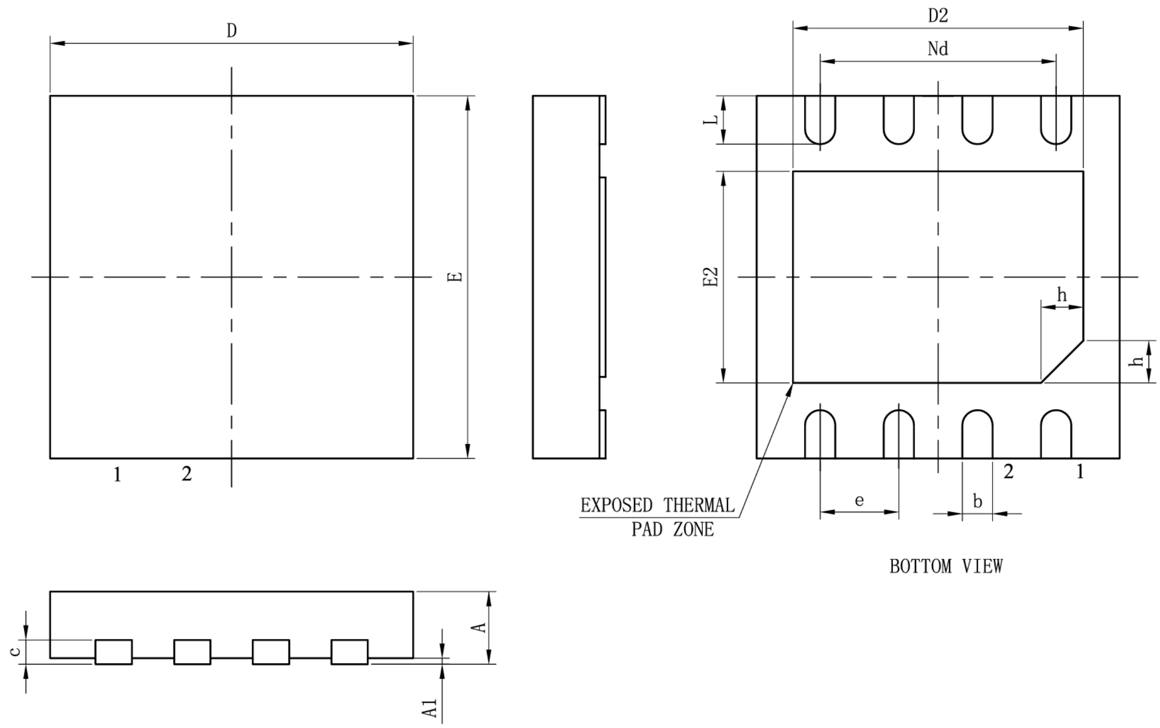
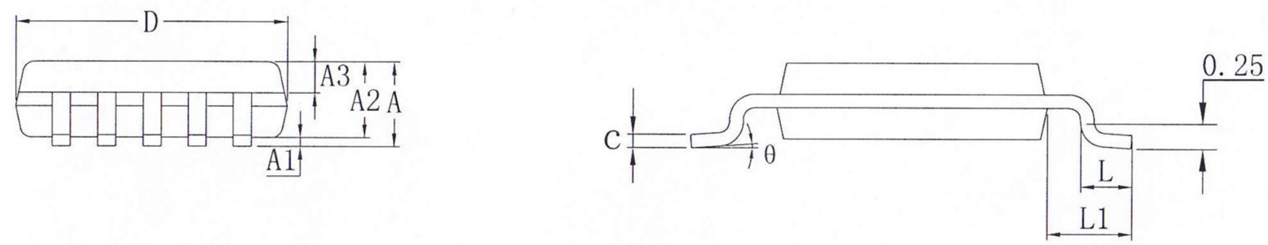


*Figure 32. DFN3*3-8L PKG POD*

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
b	0.25	0.30	0.35
b1	0.20REF		
c	0.18	0.20	0.25
D	2.90	3.00	3.10
D2	2.40	2.50	2.60
e	0.65BSC		
Nd	1.95BSC		
E	2.90	3.00	3.10
E2	1.45	1.55	1.65
L	0.30	0.40	0.50
L1	0.05REF		
L2	0.10REF		
h	0.20	0.25	0.30



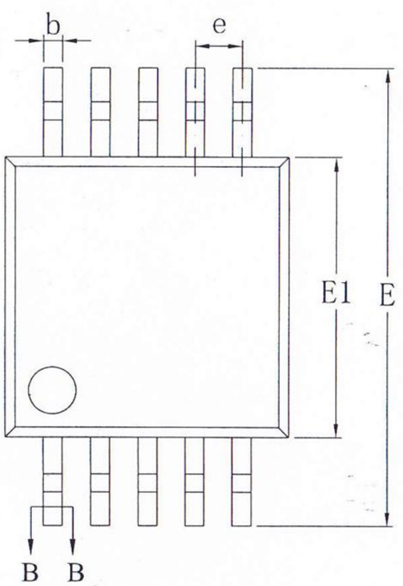
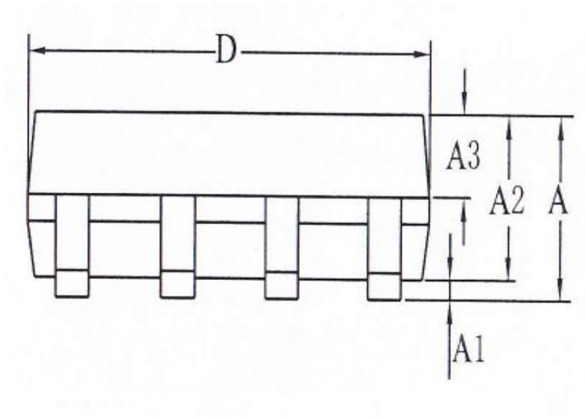
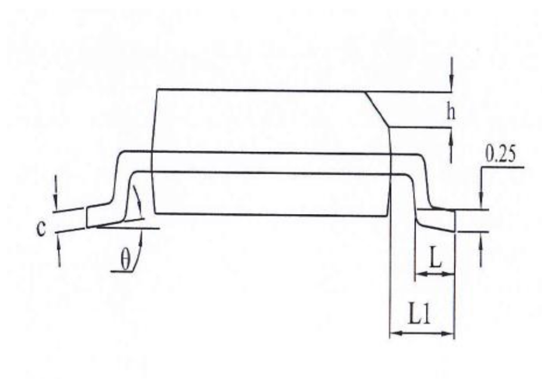


Figure 33. MSOP10L PKG POD

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	–	–	1. 10
A1	0.05	–	0. 15
A2	0. 75	0.85	0. 95
A3	0. 3	0. 35	0. 40
b	0. 18	–	0. 26
b1	0. 17	0.20	0. 23
c	0. 15	–	0. 19
c1	0. 14	0. 15	0. 16
D	2. 90	3. 00	3. 10
e	0. 50BSC		
L1	0. 95REF		
E	4. 70	4. 90	5. 10
E1	2. 90	3. 00	3. 10
L	0. 40	_	0. 70
θ	0	–	8°





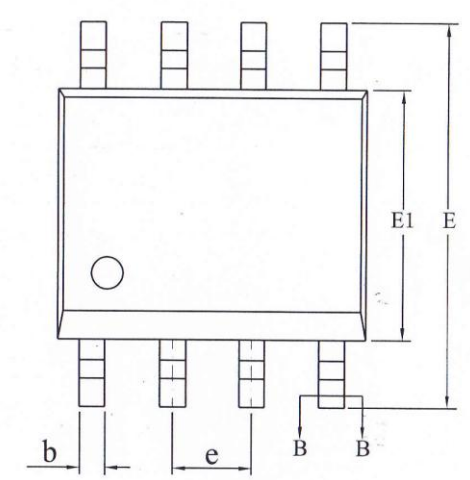


Figure 34. SOP8L PKG POD

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	-	-	1.75
A1	0.10	-	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	-	0.47
c	0.20	-	0.24
D	4.80	4.90	5.00
e	1.27BSC		
L1	1.05REF		
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
L	0.50	-	0.80
θ	0	-	8°

ORDERING INFORMATION

Device	Order Part No.	Package	QTY
AWS8611	AWS8611DFR	DFN3x3-8L, Pb-Free	3000/Reel
	AWS8611AAR	SOP8L, Pb-Free	4000/Reel
	AWS8611EAR	MSOP8L, Pb-Free	5000/Reel
	AWS8611EBR	MSOP10L, Pb-Free	5000/Reel

REVISION HISTORY

Version	Date	Descriptions
Rev. 1.0	12/2024	Initial version