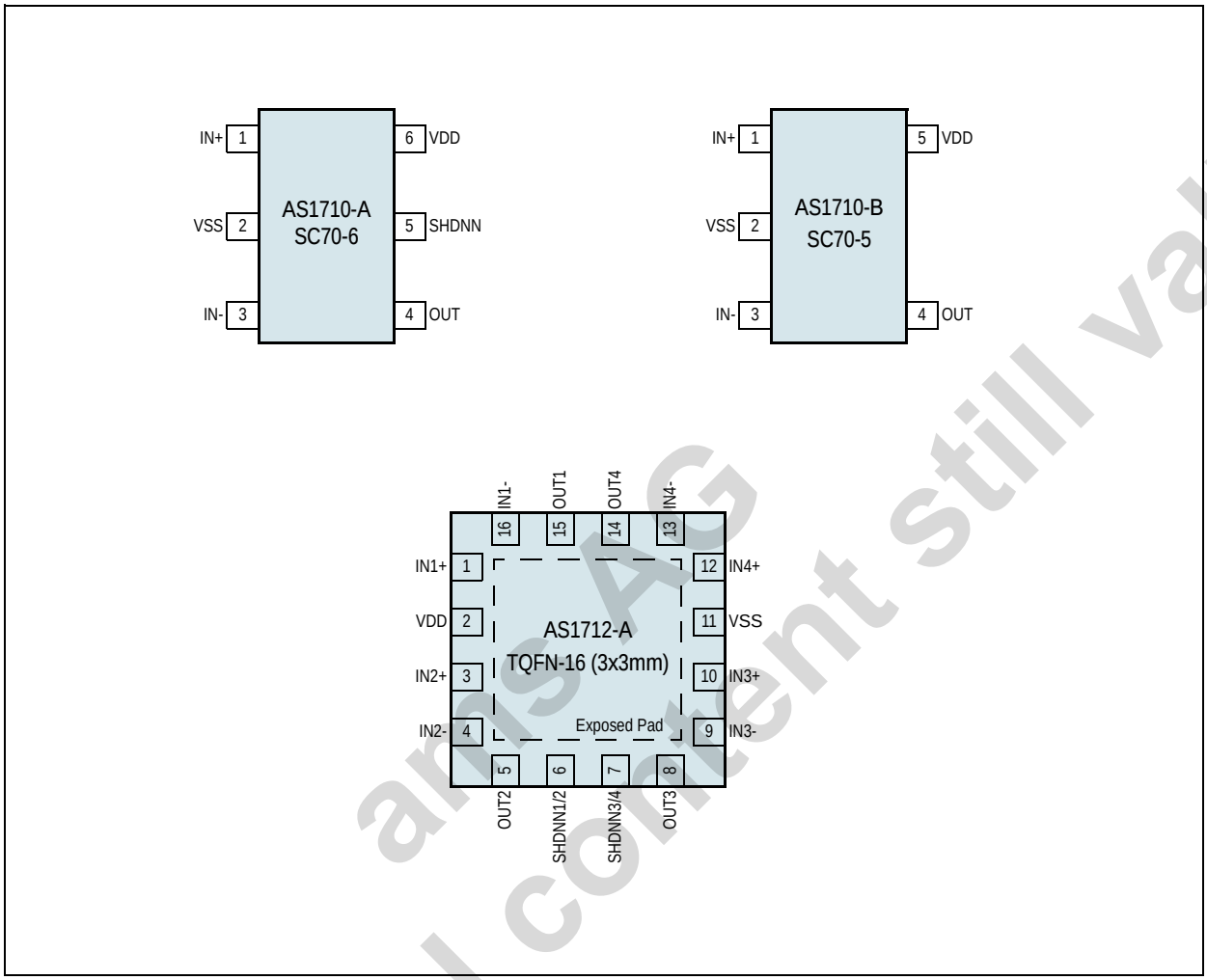
4 Pin Assignments

Figure 2. Pin Assignments (Top View)



4.1 Pin Descriptions

Table 2. Pin Descriptions

Pin Number	Pin Name	Description
See Figure 2	IN+	Non-inverting Input
	IN-	Inverting Input
	VDD	Positive Supply Input
	VSS	Negative Supply Input. This pin must be connected to ground in single-supply applications.
	SHDNN	Active Low Shutdown Control
	OUT	Amplifier Output
	Exposed Pad	Exposed Pad. This pin also functions as a heat sink. Solder it to a large pad or to the circuit-board ground plane to maximize power dissipation.

5 Absolute Maximum Ratings

Stresses beyond those listed in Table 3 may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in Electrical Characteristics on page 4 is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 3. Absolute Maximum Ratings

Parameter		Min	Max	Units	Comments
Electrical Parameters					
Supply Voltage (V_{DD} to V_{SS})			+7	V	
Supply Voltage (All Other Pins)		V_{SS} - 0.3	V_{DD} + 0.3	V	
Output Short-Circuit Duration to V_{DD} or V_{SS}			1	s	
Thermal Information					
Continuous Power Dissipation	SC70-5		247	mW	Derate at 31mW/ºC above 70ºC
	SC70-6		245		
Thermal Resistance Θ_{JA}	TQFN-16 (3x3mm)		33	ºC/W	on PCB
Temperature Ranges and Storage Conditions					
Storage Temperature Range		-65	+150	ºC	
Junction Temperature			+150	ºC	
Package Body Temperature			+260	ºC	The reflow peak soldering temperature (body temperature) specified is in accordance with *IPC/ JEDEC J-STD-020 "Moisture/Reflow Sensitivity Classification for Non-Hermetic Solid State Surface Mount Devices".* The lead finish for Pb-free leaded packages is matte tin (100% Sn).
Humidity non-condensing		5	85	%	
Moisture Sensitive Level		1			Represents a maximum floor life time of unlimited

6 Electrical Characteristics

All limits are guaranteed. The parameters with Min and Max values are guaranteed by production tests or SQC (Statistical Quality Control) methods.

6.1 DC Electrical Characteristics

V_{DD} = 2.7V, V_{SS} = 0V, V_{CM} = V_{DD}/2, V_{OUT} = V_{DD}/2, R_{LOAD} = Infinite, V_{SHDNN} = V_{DD}, Typical values at T_{AMB} = 25ºC.

Table 4. DC Electrical Characteristics

Symbol	Parameter	Condition		Min	Typ	Max	Unit
T_{AMB}	Operating Temperature Range			-40		+85	ºC
V_{DD}	Supply Voltage Range	Inferred from Power Supply Rejection Ratio Test		2.7		5.5	V
V_{OFFSET}	Input Offset Voltage			-3	0.6	+3	mV
I_{BIAS}	Input Bias Current	V_{CM} = V_{SS} to V_{DD}			50[1]		pA
I_{OFFSET}	Input Offset Current	V_{CM} = V_{SS} to V_{DD}			50[1]		pA
R_{IN}	Input Resistance				1000[1]		MΩ
V_{CM}	Common Mode Input Voltage Range	Inferred from Common Mode Rejection Ratio[1]		V_{SS}		V_{DD}	V
CMRR	Common Mode Rejection Ratio	V_{SS} < V_{CM} < V_{DD}		-45	-70		dB
PSRR	Power Supply Rejection Ratio	V_{DD} = 2.7 to 5.5V		-70	-85		dB
R_{OUT}	Shutdown Output Impedance	V_{SHDNN} = 0V (A-Versions)			130[1]		Ω
$V_{OUT-SHDNN}$	Shutdown Output Voltage	V_{SHDNN} = 0V, R_{LOAD} = 2kΩ to V_{DD} (A-Versions)			170	300	mV
A_{VOL}	Large Signal Voltage Gain	V_{SS} + 0.20V < V_{OUT} < V_{DD} - 0.20V	R_{LOAD} = 100kΩ	85	100		dB
			R_{LOAD} = 2kΩ	79	92		
			R_{LOAD} = 200Ω	69	80		
V_{OUT}	Output Voltage Swing	V_{DD} - V_{OH} or V_{OL} - V_{SS}	R_{LOAD} = 32Ω		350	650	mV
			R_{LOAD} = 200Ω		70	120	
			R_{LOAD} = 2kΩ		9	20	
	Output Voltage	V_{DD} - V_{OH} or V_{OL} - V_{SS}	I_{LOAD} = 10mA, V_{DD} = 2.7V		55	100	mV
			I_{LOAD} = 30mA, V_{DD} = 5V		100	180	
I_{OUT}	Output Source/Sink Current	V_{DD} = 2.7V, V- = V_{CM}, V+ = V_{CM}±100mV			100		mA
		V_{DD} = 5.0V, V- = V_{CM}, V+ = V_{CM}±100mV			200		
I_{DD}	Quiescent Supply Current per Op Amp Output	V_{DD} = 2.7V, V_{CM} = V_{DD}/2			1.6	3.2	mA
		V_{DD} = 5.0V, V_{CM} = V_{DD}/2			2.3	4.6	
$I_{DD-SHDNN}$	Shutdown Supply Current per Op Amp (A-Versions)	V_{SHDNN} = 0V	V_{DD} = 2.7V		1	2000[1]	nA
	SHDNN Logic Threshold (A-Versions)	Shutdown Mode			V_{SS} + 0.3		V
		Normal Operation			V_{DD} - 0.3		
	SHDNN Input Bias Current	V_{SS} < V_{SHDNN} < V_{DD} (A-Versions)			50[1]		pA

1. Guaranteed by design.

6.2 AC Electrical Characteristics

V_{DD} = 2.7V, V_{SS} = 0V, V_{CM} = V_{DD}/2, V_{OUT} = V_{DD}/2, R_{LOAD} = Infinite, V_{SHDNN} = V_{DD}, Typical values at T_{AMB} = 25ºC.

Table 5. AC Electrical Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
GBWP	Gain-Bandwidth Product	V_{CM} = V_{DD}/2		10		MHz
FPBW	Full-Power Bandwidth	V_{OUT} = 2VP-P, V_{DD} = 5V		2.5		MHz
SR	Slew Rate			10		V/µs
PM	Phase Margin			70		deg
GM	Gain Margin[1]			15		dB
THD+N	Total Harmonic Distortion Plus Noise	f = 10kHz, V_{OUT} = 2VP-P, A_{VCL} = 1V/V		0.05		%
C_{IN}	Input Capacitance			6		pF
en	Voltage-Noise Density[1]	f = 1kHz		15		nV/√Hz
		f = 10kHz		10		
	Capacitive-Load Stability	A_{VCL} = 1V/V, no sustained oscillations		100		pF
t_{SHDN}	Shutdown Time (AS1710A)			1		µs
t_{ENABLE}	Enable Time from Shutdown (AS1710A)			7		µs
t_{ON}	Power-Up Time			20		ns

1. Guaranteed by design.

7 Typical Operating Characteristics

V_{DD} = 2.7V; V_{SS} = 0V, V_{CM} = V_{DD}/2, V_{OUT} = V_{DD}/2, R_{LOAD} = ∞, V_{SHDNN} = V_{DD} T_{AMB} = +25ºC (unless otherwise specified).

Figure 3. Gain and Phase vs. Frequency

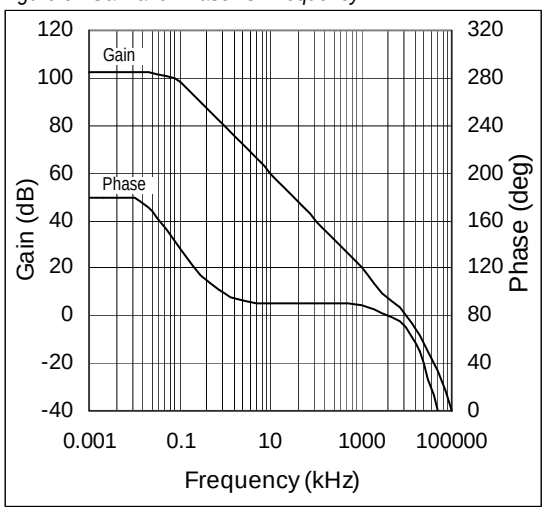


Figure 4. Gain and Phase vs. Frequency, C_{LOAD} = 100pF

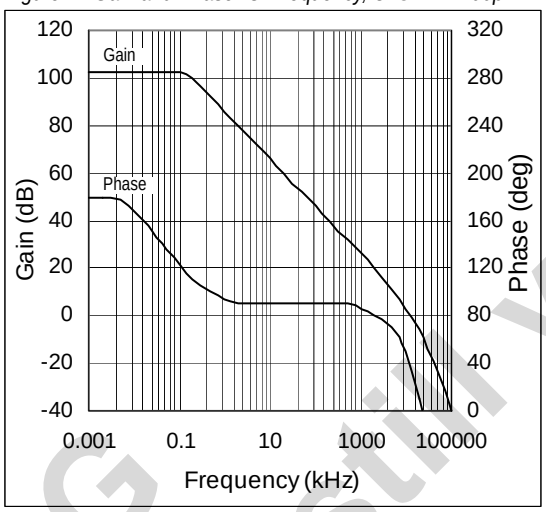


Figure 5. PSRR vs. Frequency

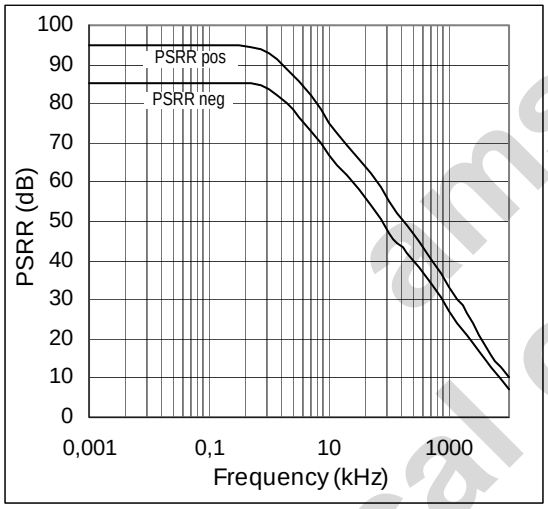


Figure 6. CMRR vs. Frequency

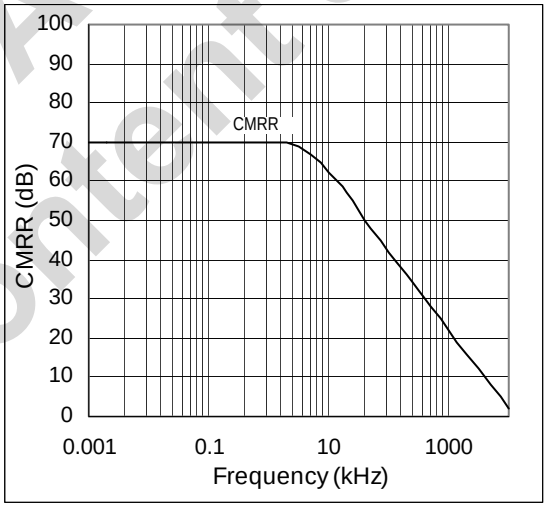


Figure 7. Supply Current vs. Temperature

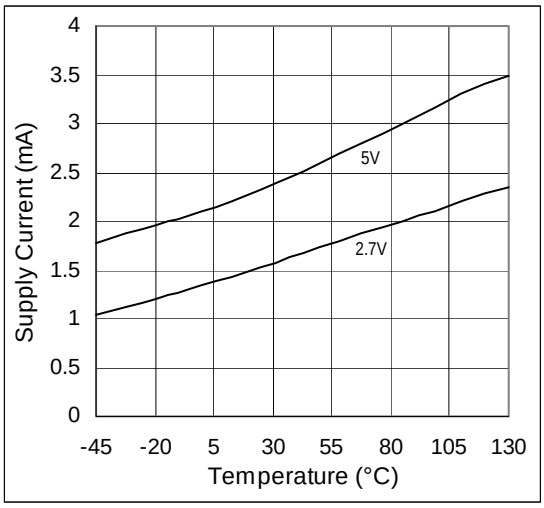


Figure 8. Shutdown Current vs. Temperature

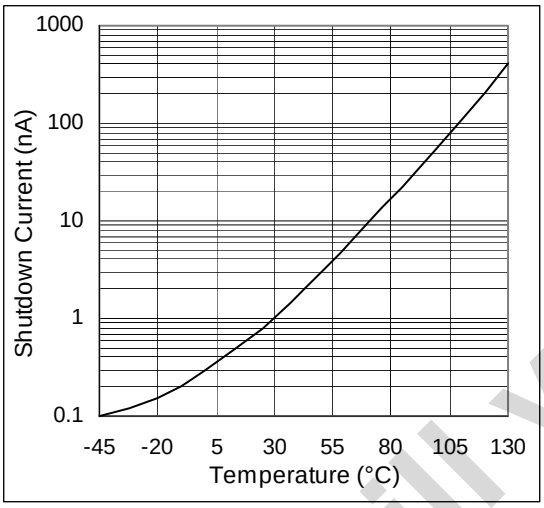


Figure 9. Supply Current vs. Common-Mode Voltage

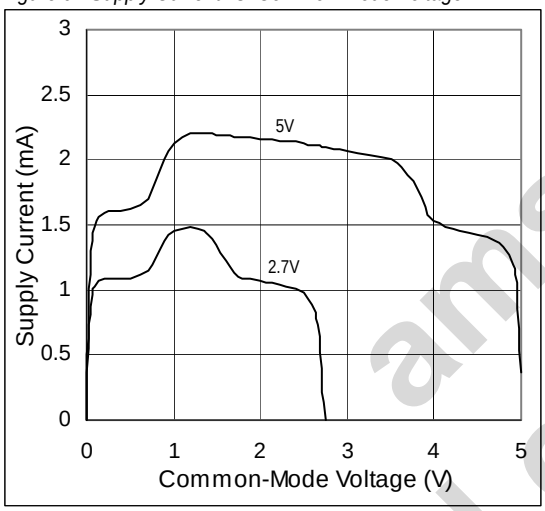


Figure 10. Input Voltage Noise vs. Frequency

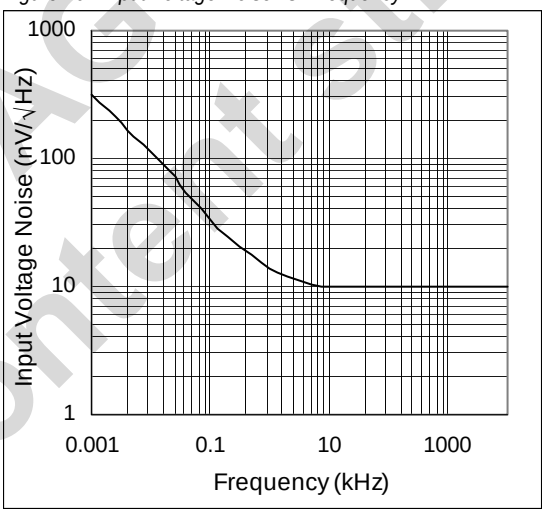


Figure 11. Output Voltage vs. Output Current, sourcing

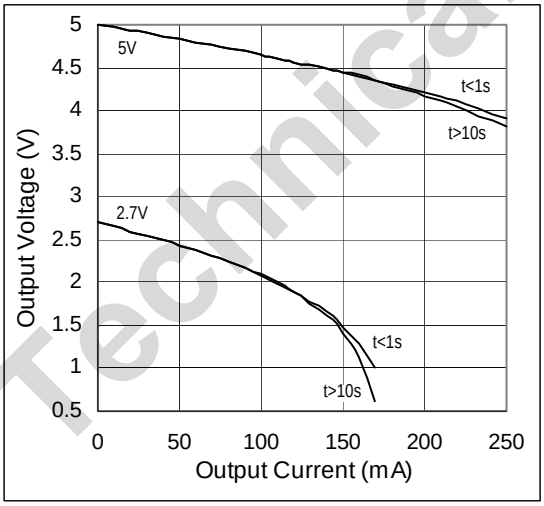


Figure 12. Output Voltage vs. Output Current, sinking

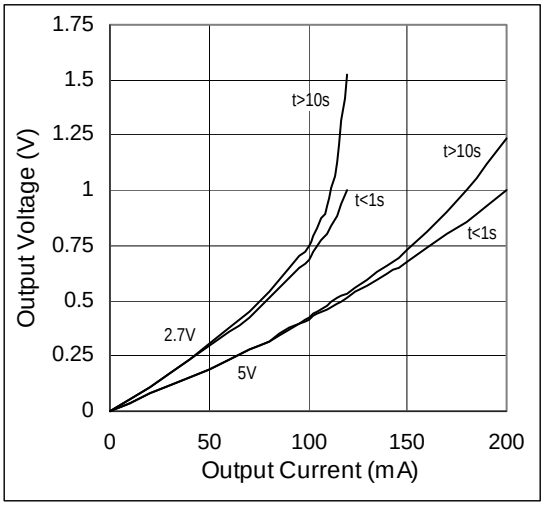


Figure 13. Output Swing High vs. Temperature

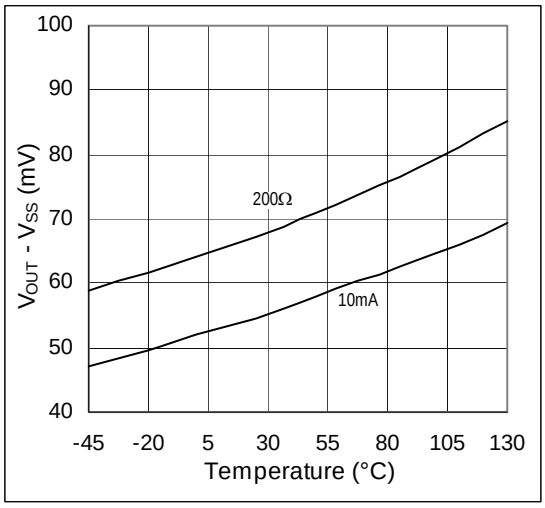


Figure 14. Output Swing Low vs. Temperature

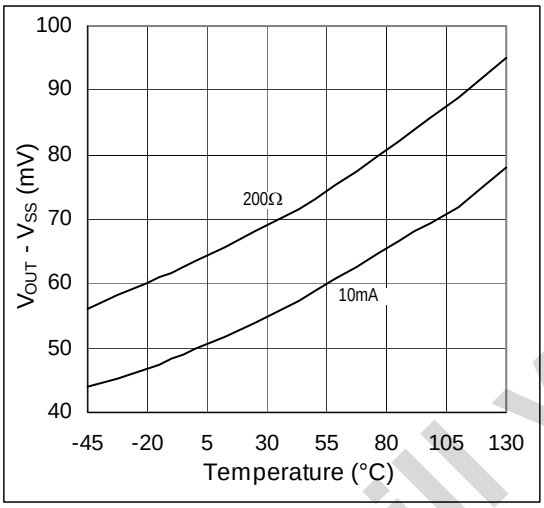


Figure 15. Transient Response, 100mV, 10pF load

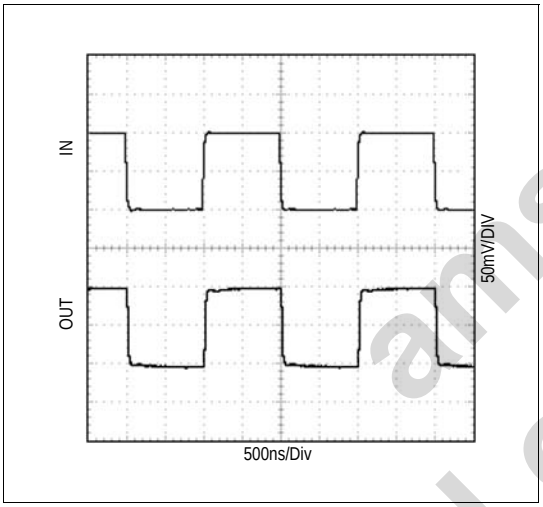


Figure 16. Transient Response, 100mV, 100pF load

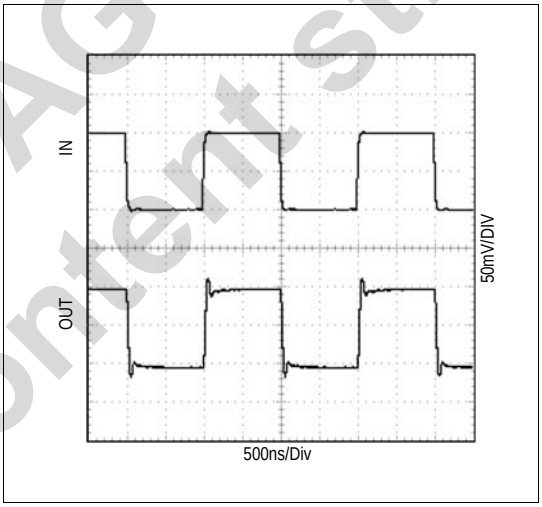


Figure 17. Transient Response, 1V, 10pF load

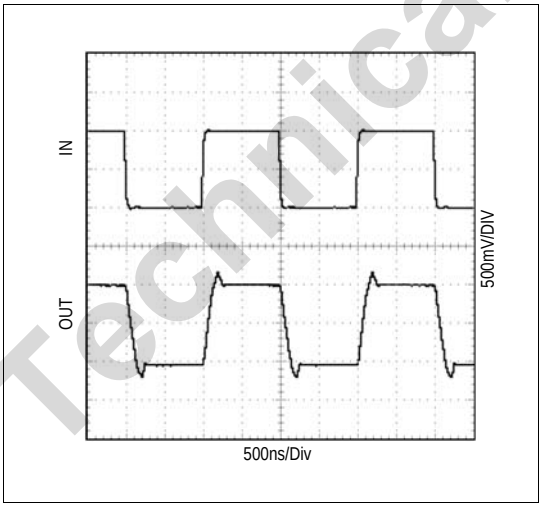


Figure 18. Transient Response, 1V, 100pF load

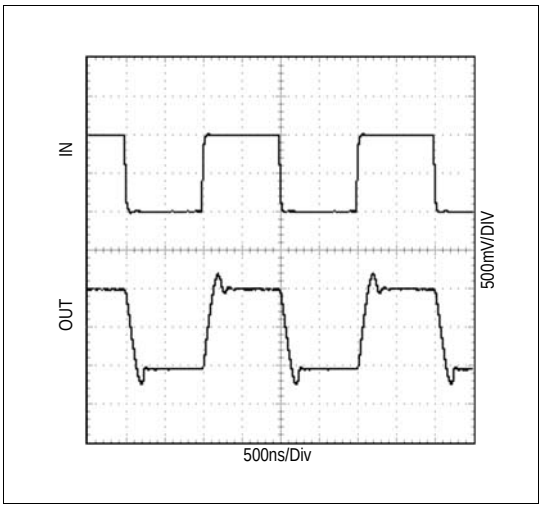


Figure 19. Transient Response, 2V, 10pF load

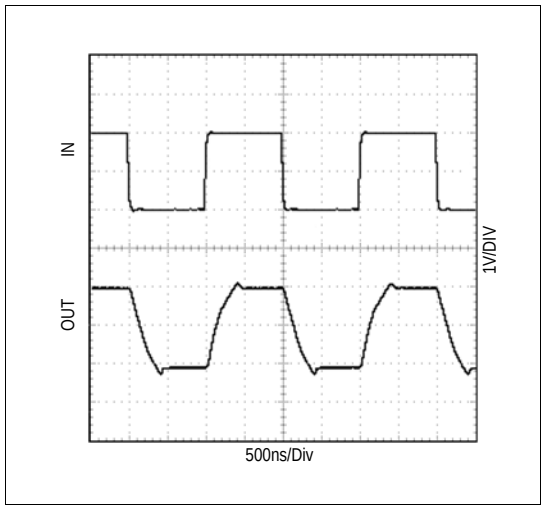
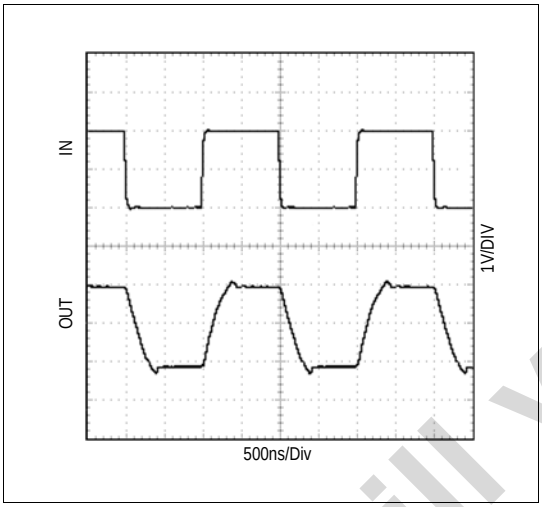


Figure 20. Transient Response, 2V, 100pF load



8 Application Information

8.1 Package Power Dissipation

Caution: Due to the high output current drive, this op-amp can exceed the absolute maximum power-dissipation rating. Normally, when peak current is less than or equal to 40mA the maximum package power dissipation is not exceeded for any of the package types offered.

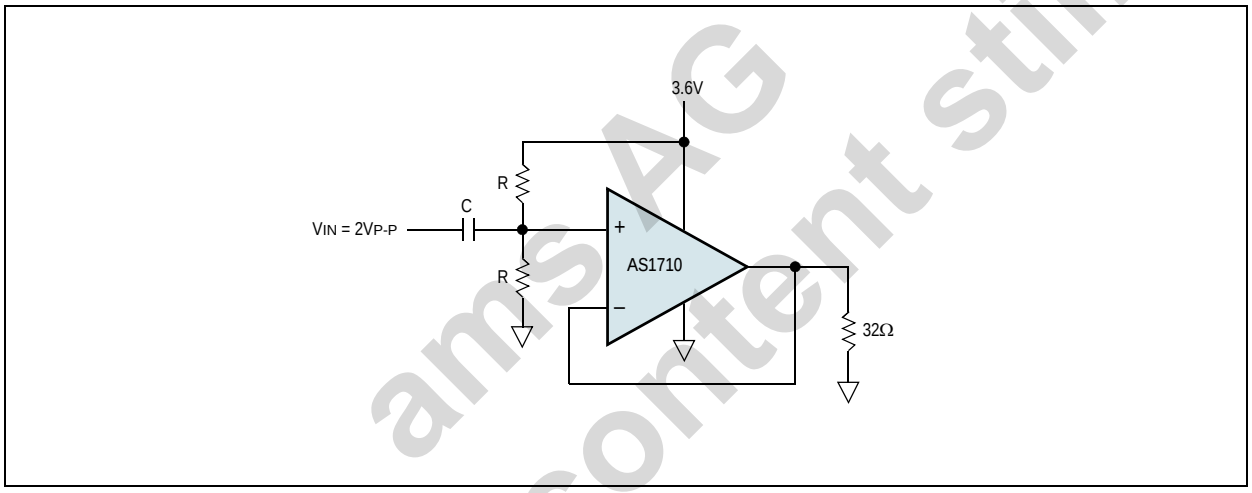
The absolute maximum power-dissipation rating of each package should always be verified. (EQ 1) gives an approximation of the package power dissipation:

$$P_{PACKAGEDISS} \cong V_{RMS} I_{RMS} \cos\theta \quad \text{(EQ 1)}$$

Where:

V_{RMS} is the RMS voltage from V_{DD} to V_{OUT} when sourcing current, and from V_{OUT} to V_{SS} when sinking current.
I_{RMS} is the RMS current flowing in or out of the op-amp and the load.
θ is the phase difference between the voltage and the current. For resistive loads, $\cos\theta = 1$.

Figure 21. Typical AS1710/AS1712 Single-Supply Application



V_{RMS} can be calculated as:

$$V_{RMS} \cong (V_{DD} - V_{DC}) + V_{PEAK} / \sqrt{2} \quad \text{(EQ 2)}$$

Where:

V_{DC} is the DC component of the output voltage.
V_{PEAK} is the highest positive excursion of the AC component of the output voltage.

For the circuit shown in Figure 21:

$$V_{RMS} = (3.6V - 1.8V) + 1.0V/\sqrt{2} = 2.507V_{RMS}$$

I_{RMS} can be calculated as:

$$I_{RMS} \cong IDC + (IPEAK/\sqrt{2}) \quad \text{(EQ 3)}$$

Where:

I_{DC} is the DC component of the output current.
I_{PEAK} is the highest positive excursion of the AC component of the output current.

For the circuit shown in Figure 21:

$$I_{RMS} = (1.8V/32\Omega) + (1.0V/32\Omega)/\sqrt{2} = 78.4mA_{RMS}$$

Therefore, for the circuit in Figure 21 the package power dissipation can be calculated as:

$$P_{PACKAGEDISS} = V_{RMS} I_{RMS} \cos\theta = 196mW$$

Adding a coupling capacitor improves the package power dissipation because there is no DC current to the load, as shown in Figure 22 on page 11.