SGM8605-1
1.2mA, 12.5MHz, Rail-to-Rail I/O CMOS Operational Amplifier

GENERAL DESCRIPTION

The SGM8605-1 (single with shutdown) is a low voltage, low noise and low power operational amplifier, which can operate from 2.1V to 5.5V single supply, while consuming only 1.2mA quiescent current at 5V. The supply current is less than 1μA in power-down mode.

The SGM8605-1 features a 4.5mV maximum input offset voltage. The minimum input common mode voltage is within 0.1V below the negative rail, and the output swing is rail-to-rail with heavy loads. It exhibits a high gain-bandwidth product of 12.5MHz and a slew rate of 8.5V/μs. These specifications make the operational amplifier appropriate for various applications.

The SGM8605-1 is available in a Green UTDFN-1.45×1-6L package. It is specified over the extended -40℃ to +125℃ industrial temperature range.

FEATURES

- **Input Offset Voltage: 0.9mV (TYP)**
- **High Gain-Bandwidth Product: 12.5MHz**
- **High Slew Rate: 8.5V/μs**
- **Settling Time to 0.1% with 2V Step: 0.21μs**
- **Overload Recovery Time: 0.6μs**
- **Rail-to-Rail Input and Output**
- **Supply Voltage Range: 2.1V to 5.5V**
- **Input Common Mode Voltage Range:**
  -0.1V to 5.6V with V_S = 5.5V
- **Low Power:**
  1.2mA (TYP) Supply Current
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green UTDFN-1.45×1-6L Package**

APPLICATIONS

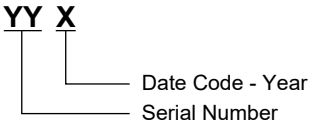
Sensors
Audio
Active Filters
A/D Converters
Communications
Test Equipment
Cellular and Cordless Phones
Laptops and PDAs
Photodiode Amplification
Battery-Powered Instrumentation

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8605-1	UTDFN-1.45×1-6L	-40℃ to +125℃	SGM8605-1XUDL6G/TR	78X	Tape and Reel, 5000

MARKING INFORMATION

NOTE: X = Date Code.



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, $+V_S$ to $-V_S$ 6V
Input Common Mode Voltage Range.....
..... $(-V_S)$ - 0.3V to $(+V_S)$ + 0.3V
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 8000V
MM 400V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range ..... 2.1V to 5.5V
Operating Temperature Range ..... -40℃ to +125℃

OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

ESD SENSITIVITY CAUTION

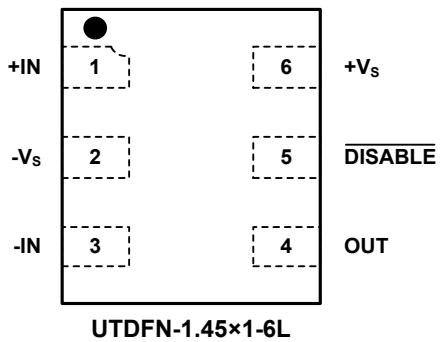
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

PIN CONFIGURATION

(TOP VIEW)



UTDFN-1.45×1-6L

ELECTRICAL CHARACTERISTICS

(At V_S = +5V, T_A = +25℃, V_{CM} = +V_S/2, R_L = 600Ω, unless otherwise noted.)

PARAMETER	CONDITIONS	SGM8605-1				
		TYP	MIN/MAX OVER TEMPERATURE			
		+25℃	+25℃	-40℃ to +125℃	UNITS	MIN/MAX
Input Characteristics						
Input Offset Voltage (V_{OS})		0.9	4.5	4.8	mV	MAX
Input Bias Current (I_B)		2			pA	TYP
Input Offset Current (I_{OS})		3			pA	TYP
Input Common Mode Voltage Range (V_{CM})	V_S = 5.5V	-0.1 to 5.6			V	TYP
Common Mode Rejection Ratio (CMRR)	V_S = 5.5V, V_{CM} = -0.1V to 4V	79	68	65	dB	MIN
	V_S = 5.5V, V_{CM} = -0.1V to 5.6V	75	60	58	dB	MIN
Open-Loop Voltage Gain (A_{OL})	R_L = 600Ω, V_{OUT} = 0.15V to 4.85V	88	80	67	dB	MIN
	R_L = 10kΩ, V_{OUT} = 0.05V to 4.95V	100	96	75	dB	MIN
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$)		2			μV/℃	TYP
Output Characteristics						
Output Voltage Swing from Rail	R_L = 600Ω	74	96	123	mV	TYP
	R_L = 10kΩ	6	13	19	mV	TYP
Output Current (I_{OUT})		78	59	50	mA	MIN
Closed-Loop Output Impedance	f = 1MHz, G = +1	8.5			Ω	TYP
Power-Down Disable						
Turn-On Time		1			μs	TYP
Turn-Off Time		0.2			μs	TYP
$\overline{\text{DISABLE}}$ Voltage-Off			0.8		V	MAX
$\overline{\text{DISABLE}}$ Voltage-On			2		V	MIN
Power Supply						
Operating Voltage Range			2.1	2.1	V	MIN
			5.5	5.5	V	MAX
Power Supply Rejection Ratio (PSRR)	V_S = 2.1V to 5.5V, V_{CM} = (-V_S) + 0.5V	75	67	61	dB	MIN
Quiescent Current (I_Q)	I_{OUT} = 0	1.2	1.5	1.9	mA	MAX
Supply Current when Disabled		0.5	8	10	μA	MAX
Dynamic Performance						
Gain-Bandwidth Product (GBP)	R_L = 600Ω	12.5			MHz	TYP
Phase Margin (φ_O)		65			degrees	TYP
Slew Rate (SR)	G = +1, 2V output step	8.5			V/μs	TYP
Settling Time to 0.1% (t_S)	G = +1, 2V output step	0.21			μs	TYP
Overload Recovery Time	V_{IN} × G = V_S	0.6			μs	TYP
Noise Performance						
Input Voltage Noise Density (e_n)	f = 1kHz	12			nV/$\sqrt{\text{Hz}}$	TYP
	f = 10kHz	8			nV/$\sqrt{\text{Hz}}$	TYP

ELECTRICAL CHARACTERISTICS (continued)

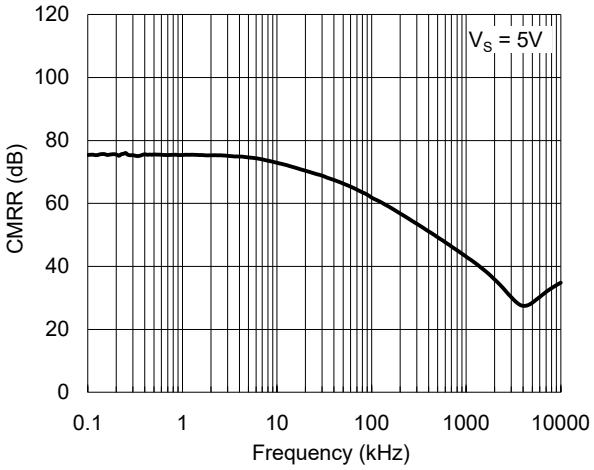
(At V_S = +2.1V, T_A = +25℃, V_{CM} = +V_S/2, R_L = 600Ω, unless otherwise noted.)

PARAMETER	CONDITIONS	SGM8605-1				
		TYP	MIN/MAX OVER TEMPERATURE			
		+25℃	+25℃	-40℃ to +125℃	UNITS	MIN/MAX
Input Characteristics						
Input Offset Voltage (V_{OS})		0.8	4.7	4.9	mV	MAX
Input Bias Current (I_B)		2			pA	TYP
Input Offset Current (I_{OS})		3			pA	TYP
Input Common Mode Voltage Range (V_{CM})	V_S = 2.1V	-0.1 to 2.2			V	TYP
Common Mode Rejection Ratio (CMRR)	V_S = 2.1V, V_{CM} = -0.1V to 0.6V	70	60	50	dB	MIN
	V_S = 2.1V, V_{CM} = -0.1V to 2.2V	70	54	49	dB	MIN
Open-Loop Voltage Gain (A_{OL})	R_L = 600Ω, V_{OUT} = 0.15V to 1.95V	87	81	64	dB	MIN
	R_L = 10kΩ, V_{OUT} = 0.05V to 2.05V	97	90	72	dB	MIN
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$)		2			μV/℃	TYP
Output Characteristics						
Output Voltage Swing from Rail	R_L = 600Ω	38	58	70	mV	TYP
	R_L = 10kΩ	5	9	11	mV	TYP
Output Current (I_{OUT})		28	20	15	mA	MIN
Power-Down Disable						
Turn-On Time		7.4			μs	TYP
Turn-Off Time		0.4			μs	TYP
$\overline{\text{DISABLE}}$ Voltage-Off			0.4		V	MAX
$\overline{\text{DISABLE}}$ Voltage-On			1.8		V	MIN
Power Supply						
Quiescent Current (I_Q)	I_{OUT} = 0	1.3	1.55	1.9	mA	MAX
Supply Current when Disabled		0.5	4	6	μA	MAX
Dynamic Performance						
Gain-Bandwidth Product (GBP)	R_L = 600Ω	12.5			MHz	TYP
Phase Margin (φ_O)		60			degrees	TYP
Slew Rate (SR)	G = +1, 1V output step	8.9			V/μs	TYP
Settling Time to 0.1% (t_S)	G = +1, 1V output step	0.24			μs	TYP
Overload Recovery Time	V_{IN} × G = V_S	0.53			μs	TYP
Noise Performance						
Input Voltage Noise Density (e_n)	f = 1kHz	12.5			nV/√Hz	TYP
	f = 10kHz	9			nV/√Hz	TYP

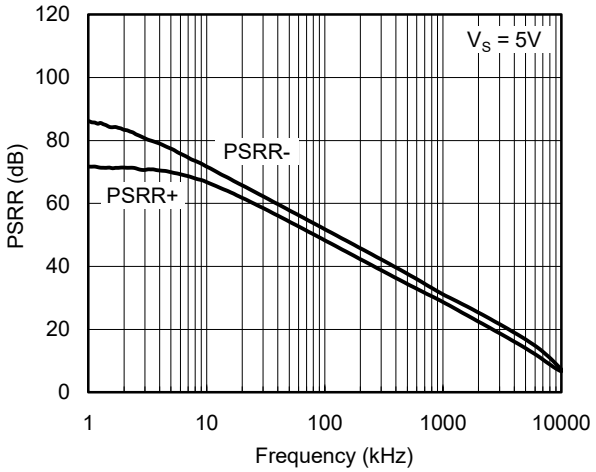
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.

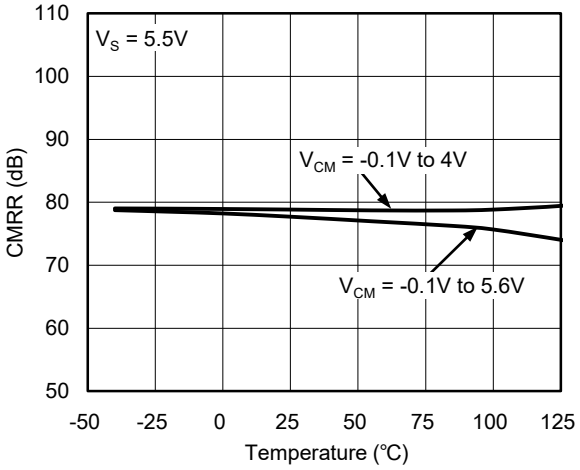
CMRR vs. Frequency



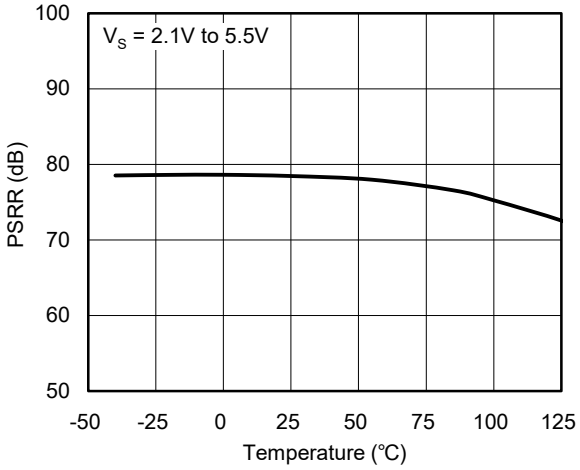
PSRR vs. Frequency



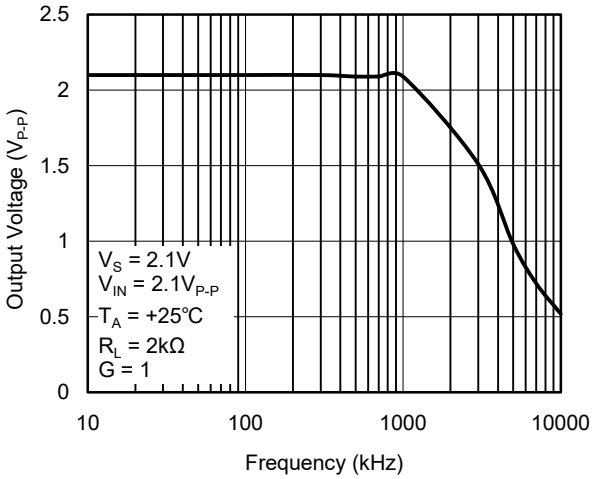
CMRR vs. Temperature



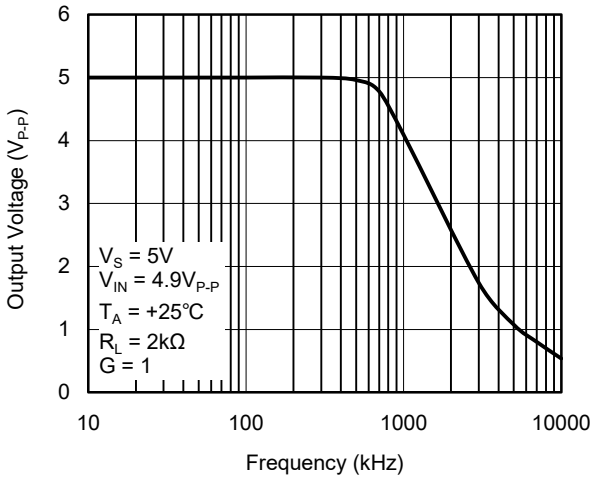
PSRR vs. Temperature



Closed-Loop Output Voltage Swing



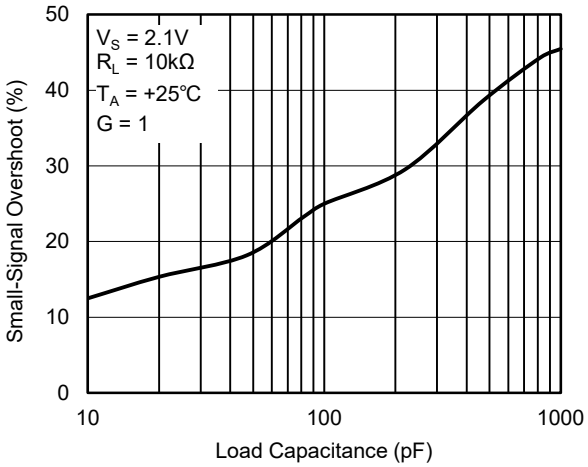
Closed-Loop Output Voltage Swing



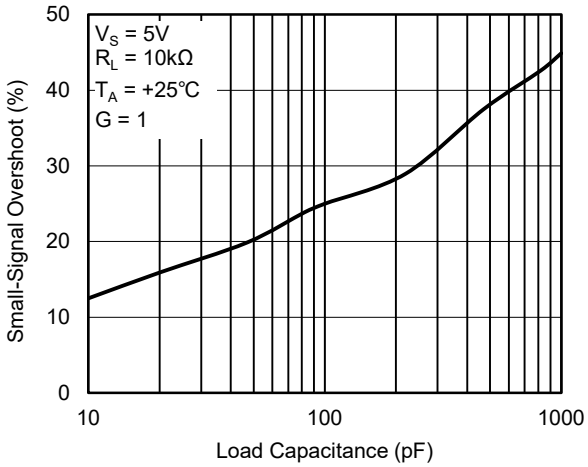
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.

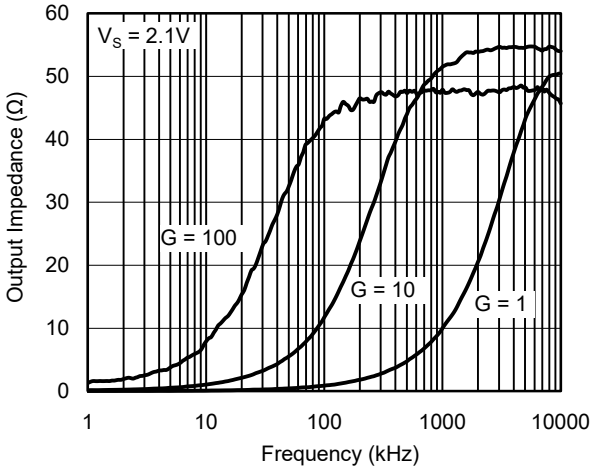
Small-Signal Overshoot vs. Load Capacitance



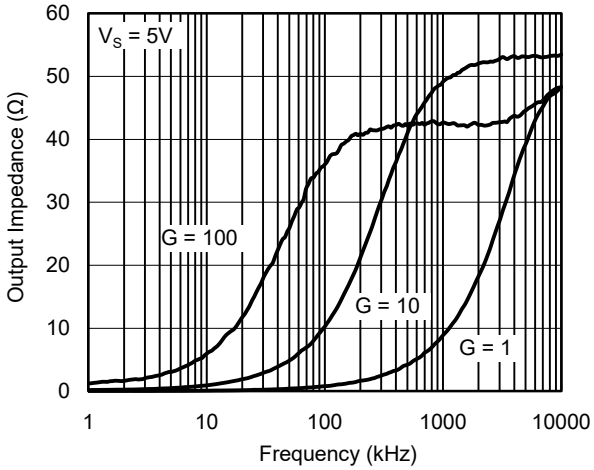
Small-Signal Overshoot vs. Load Capacitance



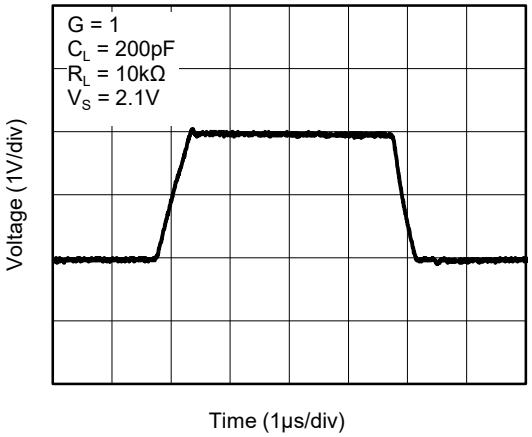
Output Impedance vs. Frequency



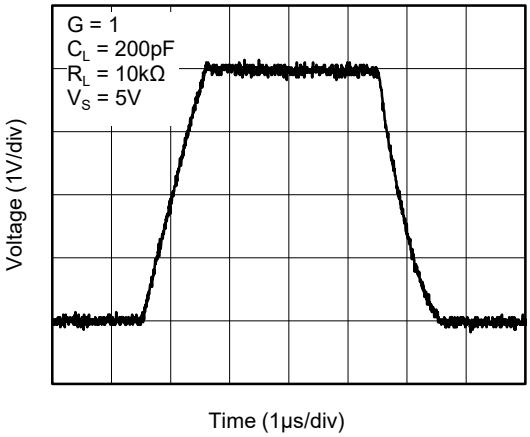
Output Impedance vs. Frequency



Large-Signal Step Response



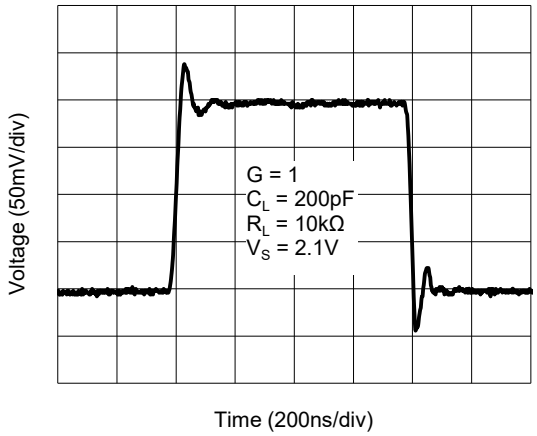
Large-Signal Step Response



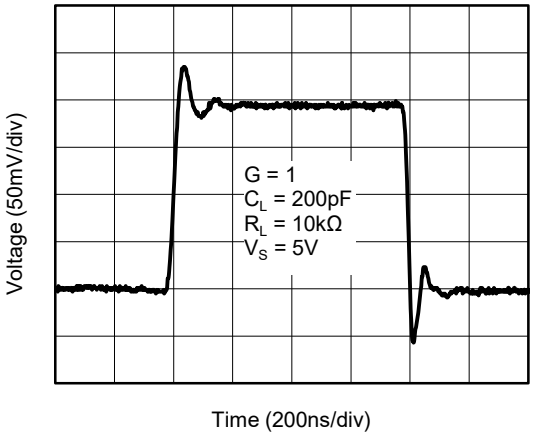
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.

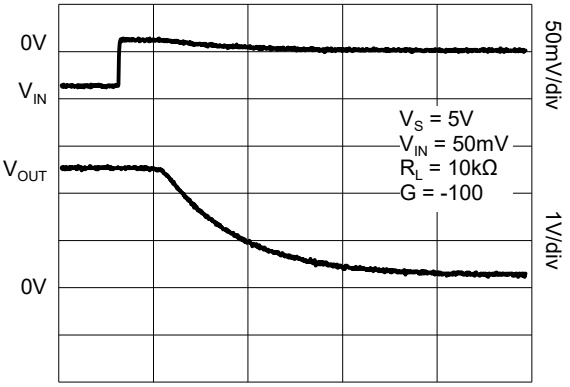
Small-Signal Step Response



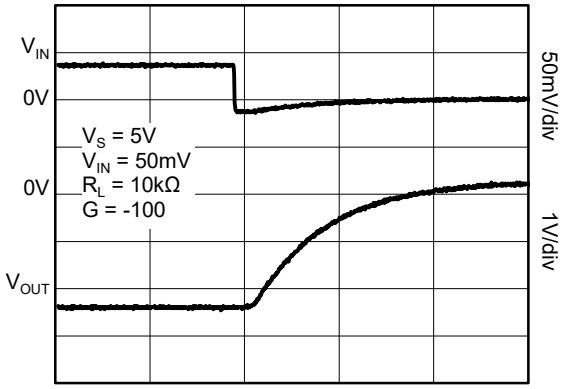
Small-Signal Step Response



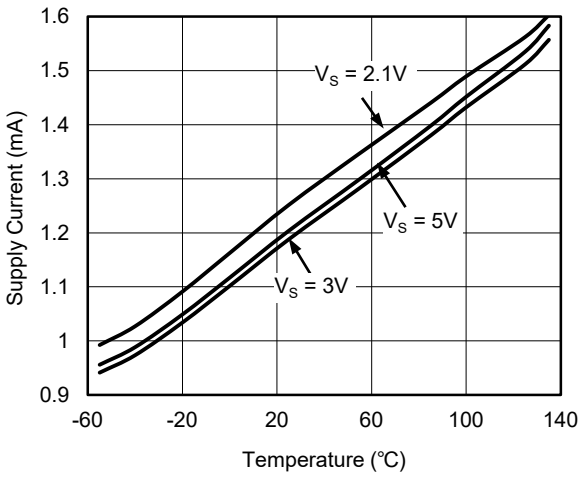
Positive Overload Recovery



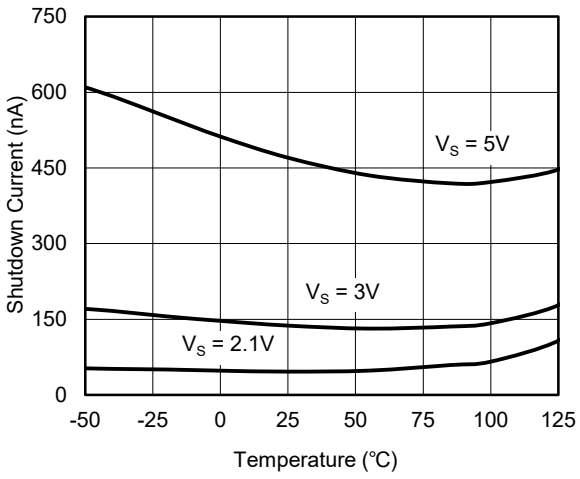
Negative Overload Recovery



Supply Current vs. Temperature



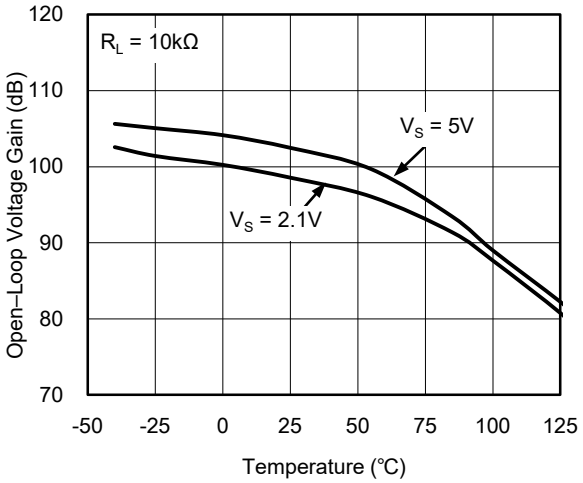
Shutdown Current vs. Temperature



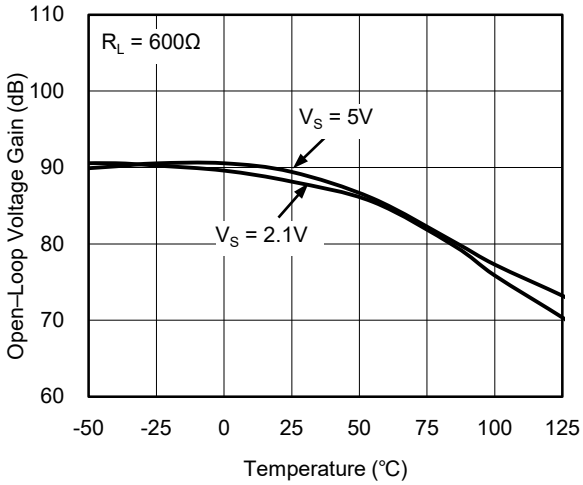
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{CM} = V_S/2, R_L = 600Ω, unless otherwise noted.

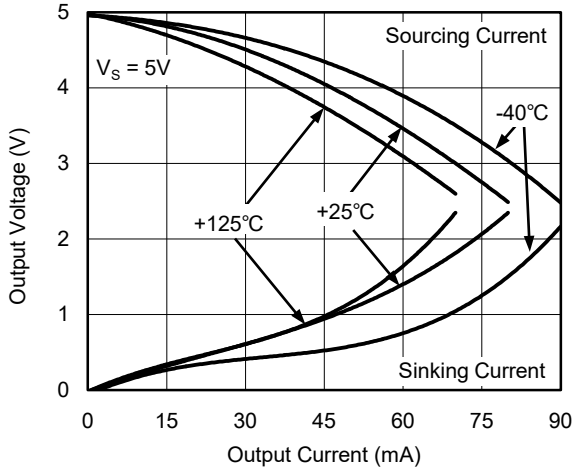
Open-Loop Voltage Gain vs. Temperature



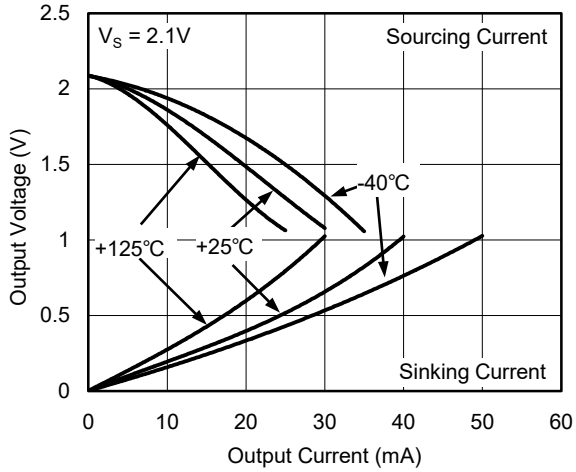
Open-Loop Voltage Gain vs. Temperature



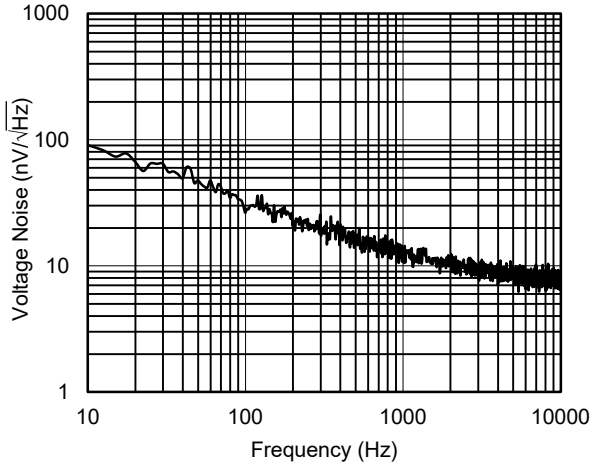
Output Voltage Swing vs. Output Current



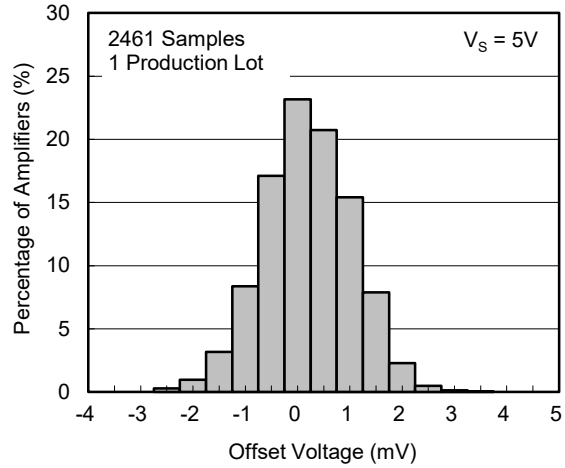
Output Voltage Swing vs. Output Current



Input Voltage Noise Spectral Density vs. Frequency



Offset Voltage Production Distribution



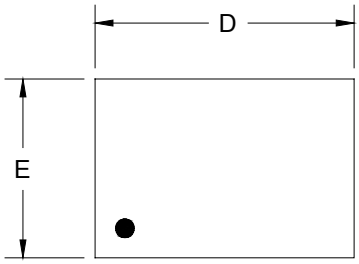
REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

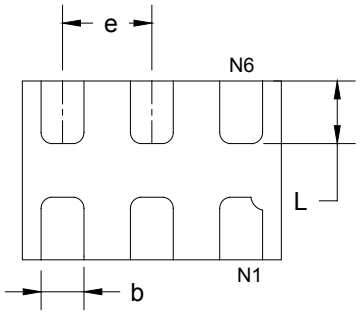
Changes from Original (MARCH 2016) to REV.A	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

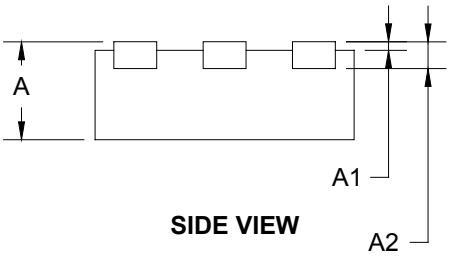
UTDFN-1.45×1-6L



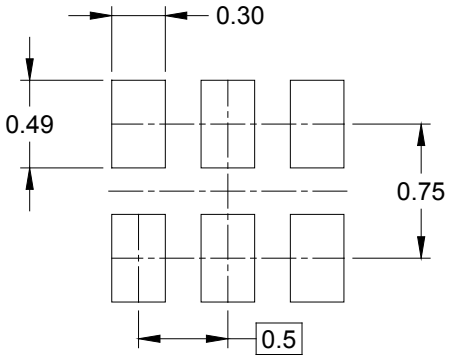
TOP VIEW



BOTTOM VIEW



SIDE VIEW

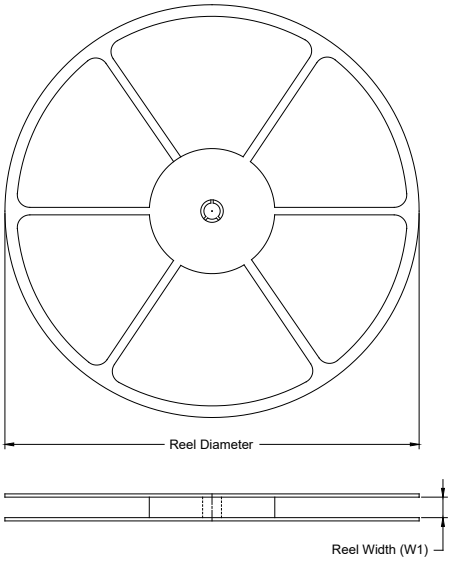


RECOMMENDED LAND PATTERN (Unit: mm)

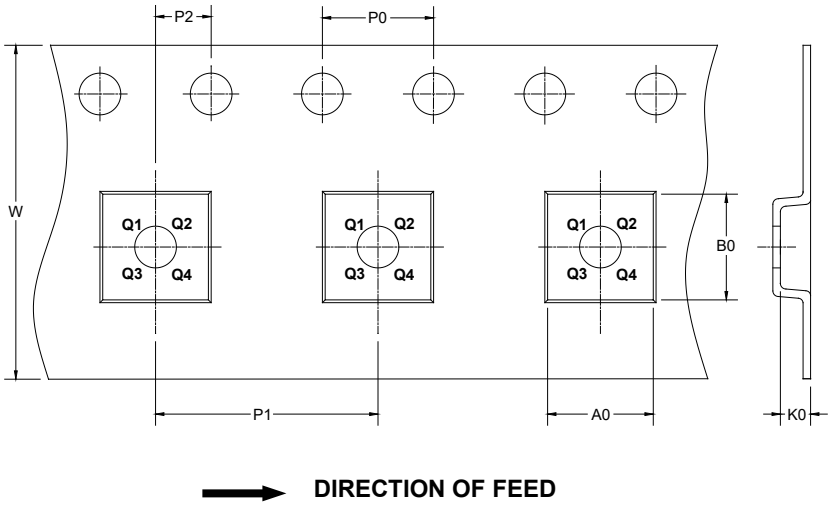
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.450	0.550	0.018	0.022
A1	0.000	0.050	0.000	0.002
A2	0.150 REF		0.006 REF	
D	1.374	1.526	0.054	0.060
E	0.924	1.076	0.036	0.042
b	0.180	0.300	0.007	0.012
e	0.500 TYP		0.020 TYP	
L	0.274	0.426	0.011	0.017

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



DIRECTION OF FEED

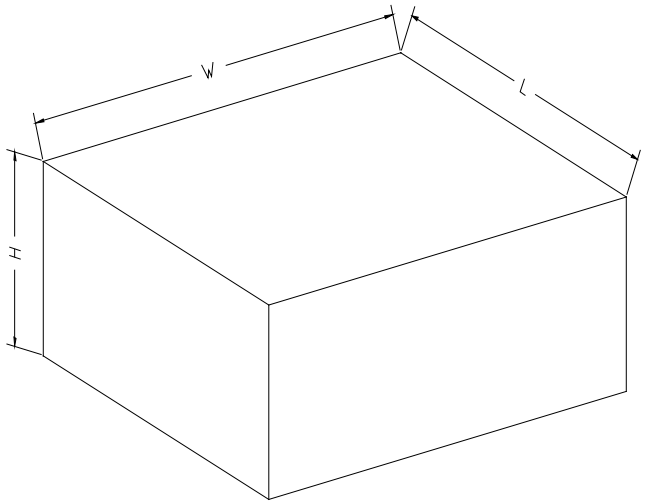
NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
UTDFN-1.45×1-6L	7″	9.5	1.15	1.60	0.75	4.0	4.0	2.0	8.0	Q1

DD0001

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7″ (Option)	368	227	224	8
7″	442	410	224	18

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