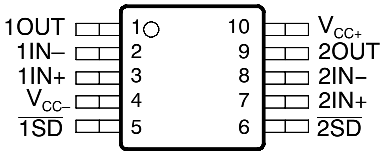
FEATURES

- **5-MHz Gain Bandwidth Product**
- **5-V/μs Slew Rate**
- **Low Noise: 20 nV/√Hz**
- **1.22-mA/Channel Supply Current**
- **V_{OS} < 3 mV Max**
- **Low Supply Voltage: 2.7 V to 5 V**
- **Rail-to-Rail Inputs and Outputs**
- **Unity Gain Stable**
- **1.5-μA Shutdown I_{CC}**
- **2.2-μs Turn On**

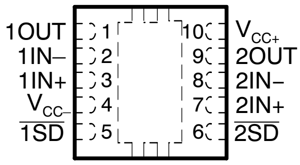
APPLICATIONS

- **Power-Amplifier Control Loops**
- **Cellular Phones**
- **Portable Equipment**
- **Wireless LANs**
- **Radio Systems**
- **Cordless Phones**

DGS PACKAGE
(TOP VIEW)



DRC PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

The LMV712 dual operational amplifier is a high-performance BiCMOS operational amplifier intended for applications requiring rail-to-rail inputs, combined with speed and low noise. The device offers a bandwidth of 5 MHz, a slew rate of 5 V/μs, and operates with capacitive loads of up to 200 pF without oscillation.

The LMV712 offers two independent shutdown ($\overline{1SD}$, $\overline{2SD}$) pins. This feature allows disabling of each device separately and reduces the supply current to less than 1 μA typical. The output voltage rapidly and smoothly ramps up with no glitch as the amplifier comes out of the shutdown mode.

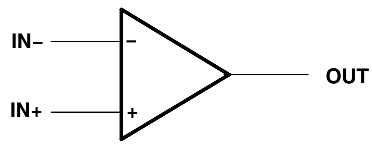
The LMV712 is offered in the space-saving SON (DRC) package and in an MSOP (DGS) package. These packages are designed to meet the demands of small size, low power, and low cost required by cellular phones and similar battery-operated portable electronics.

ORDERING INFORMATION

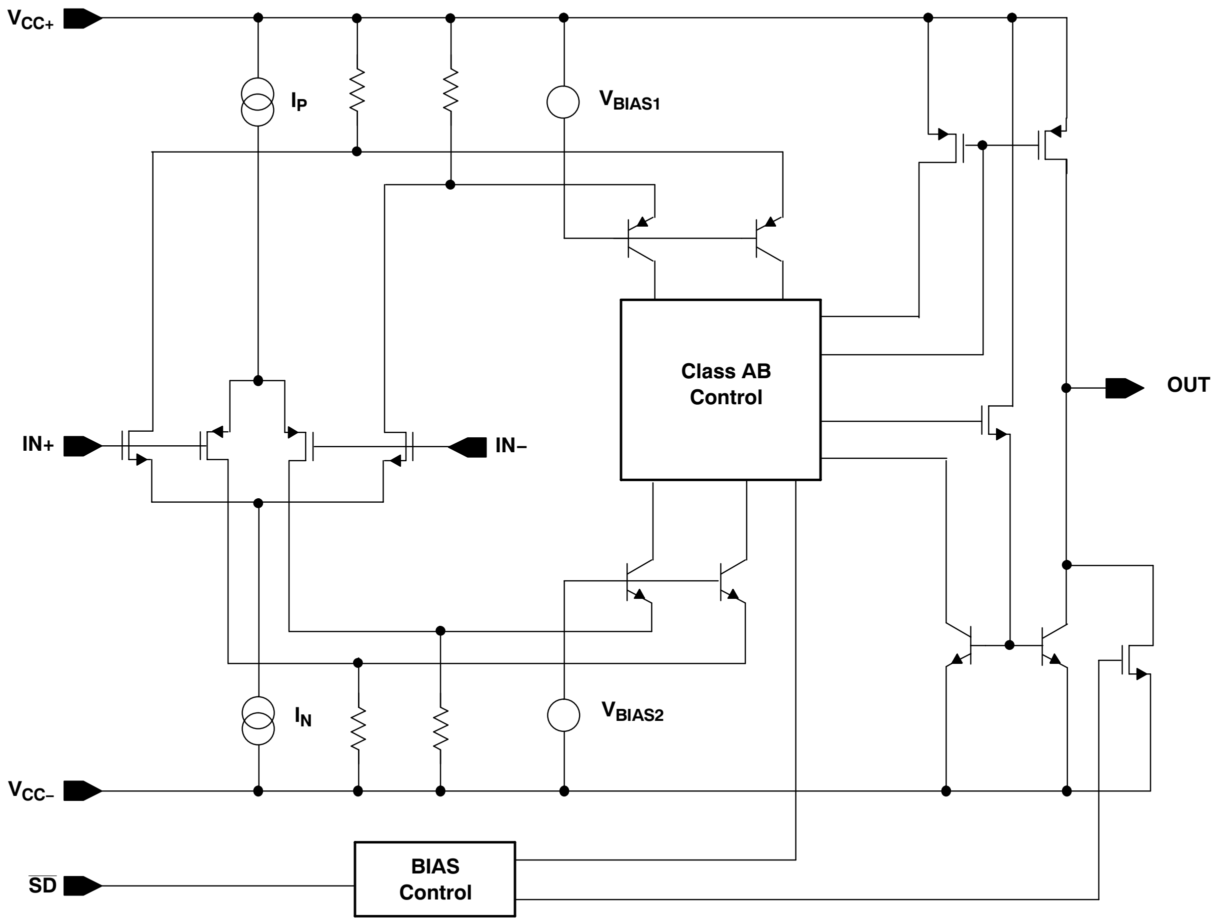
T_A	PACKAGE(1)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	MSOP – DGS	Reel of 2500	LMV712IDGSR	RNB
		Reel of 250	LMV712IDGST	
	SON – DRC	Reel of 3000	LMV712IDRCR	PREVIEW
		Reel of 250	LMV712IDRCT	

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

SYMBOL (EACH AMPLIFIER)



SIMPLIFIED SCHEMATIC (EACH AMPLIFIER)



Absolute Maximum Ratings[1]

over operating free-air temperature range (unless otherwise noted)

			MIN	MAX	UNIT
$V_{CC+} - V_{CC-}$	Supply voltage[2]			5.5	V
V_{ID}	Differential input voltage[3]			±Supply voltage	V
V_I	Input voltage range (any input)		$V_{CC-} - 0.4$	$V_{CC+} + 0.4$	V
V_O	Output voltage range		$V_{CC-} - 0.4$	$V_{CC+} + 0.4$	V
I_I	Input current[4]			±10	mA
I_O	Output current			±50	mA
θ_{JA}	Package thermal impedance[5][6]	DGS package		165	°C/W
		DRC package		TBD	
T_J	Operating virtual junction temperature			150	°C
T_{stg}	Storage temperature range		–65	150	°C

(1) Stresses beyond those listed under "absolute maximum ratings" 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 under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values (except differential voltages and V_{CC} specified for the measurement of I_{OS}) are with respect to the network GND.
(3) Differential voltages are at IN+ with respect to IN–.
(4) Excessive input current will flow if a differential input voltage in excess of approximately 0.6 V is applied between the inputs, unless some limiting resistance is used.
(5) Maximum power dissipation is a function of T_J(max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
(6) The package thermal impedance is calculated in accordance with JESD 51-7.

ESD Protection

	TYP	UNIT
Human-Body Model	1500	V
Machine Model	150	V

Recommended Operating Conditions

		MIN	MAX	UNIT
$V_{CC+} - V_{CC-}$	Supply voltage	2.7	5	V
T_A	Operating free-air temperature	–40	85	°C

Electrical Characteristics

V_{CC+} = 2.7 V, V_{CC-} = GND, V_{CM} = 1.35 V, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	V_{CM} = 0.85 V and 1.85 V		25°C		0.4	3	mV
				–40°C to 85°C			3.2	
I_{IB}	Input bias current			25°C		5.5	115	pA
				–40°C to 85°C			130	
CMRR	Common-mode rejection ratio	0 ≤ V_{CM} ≤ 2.7 V		25°C	50	75		dB
				–40°C to 85°C	45			
PSRR	Power-supply rejection ratio	2.7 V ≤ V_{CC+} ≤ 5 V	V_{CM} = 0.85 V	25°C	70	90		dB
				–40°C to 85°C	68			
			V_{CM} = 1.85 V	25°C	70	90		
				–40°C to 85°C	68			
CMVR	Common-mode voltage range	CMRR ≥ 50 dB		25°C		–0.3	–0.2	V
					2.9	3		
I_{SC}	Output short-circuit current (1)	Sourcing V_O = 0		25°C	15	25		mA
				–40°C to 85°C	12			
		Sinking V_O = 2.7 V		25°C	25	50		
				–40°C to 85°C	22			
V_O	Output voltage swing	R_L = 10 kΩ to 1.35 V	V_{OH}	25°C	2.62	2.68		V
				–40°C to 85°C	2.6			
			V_{OL}	25°C		0.01	0.12	
				–40°C to 85°C			0.15	
		R_L = 600 Ω to 1.35 V	V_{OH}	25°C	2.52	2.55		
				–40°C to 85°C	2.5			
			V_{OL}	25°C		0.05	0.23	
				–40°C to 85°C			0.3	
$V_{O(SD)}$	Output voltage level in shutdown mode			25°C		10	200	mV
I_{CC}	Supply current per channel	ON mode		25°C		1.22	1.7	mA
				–40°C to 85°C			1.9	
		Shutdown mode		25°C		0.12	1.5	μA
				–40°C to 85°C			2	
A_{VOL}	Large-signal voltage gain	Sourcing R_L = 10 kΩ, V_O = 1.35 V to 2.3 V		25°C	80	115		dB
				–40°C to 85°C	76			
		Sinking R_L = 10 kΩ, V_O = 0.4 V to 1.35 V		25°C	80	113		
				–40°C to 85°C	76			
		Sourcing R_L = 600 Ω, V_O = 1.35 V to 2.2 V		25°C	80	97		
				–40°C to 85°C	76			
		Sinking R_L = 600 Ω, V_O = 0.5 V to 1.35 V		25°C	80	100		
				–40°C to 85°C	76			
V_{SD}	Shutdown pin voltage	ON mode		25°C	2.4 to 2.7	2 to 2.7		V
		Shutdown mode			0 to 0.8	0 to 1		
GBWP	Gain bandwidth product			25°C		5		MHz
SR (2)	Slew rate			25°C		5		V/μs
Φ_m	Phase margin			25°C		60		°
V_n	Input referred voltage noise	f = 1 kHz		25°C		20		nV/√Hz

(1) Shorting the output to either supply rail adversely affects reliability.
(2) Number specified is the slower of the positive and negative slew rates.

Electrical Characteristics (continued)

V_{CC+} = 2.7 V, V_{CC-} = GND, V_{CM} = 1.35 V, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
$T_{(on)}$	Turn-on time from shutdown		25°C		2.2	4	μs
						4.6	

Electrical Characteristics

V_{CC+} = 5 V, V_{CC-} = GND, V_{CM} = 2.5 V, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	V_{CM} = 0.85 V and 1.85 V		25°C		0.4	3	mV
				–40°C to 85°C			3.2	
I_{IB}	Input bias current			25°C		5.5	115	pA
				–40°C to 85°C			130	
CMRR	Common-mode rejection ratio	0 ≤ V_{CM} ≤ 5 V		25°C	50	80		dB
				–40°C to 85°C	45			
PSRR	Power-supply rejection ratio	2.7 V ≤ V_{CC+} ≤ 5 V	V_{CM} = 0.85 V	25°C	70	90		dB
				–40°C to 85°C	68			
			V_{CM} = 1.85 V	25°C	70	90		
				–40°C to 85°C	68			
CMVR	Common-mode voltage range	CMRR ≥ 50 dB		25°C		–0.3	–0.2	V
					5.2	5.3		
I_{SC}	Output short-circuit current (1)	Sourcing V_O = 0		25°C	20	35		mA
				–40°C to 85°C	18			
		Sinking V_O = 5 V		25°C	25	50		
				–40°C to 85°C	21			
V_O	Output voltage swing	R_L = 10 kΩ to 2.5 V	V_{OH}	25°C	4.92	4.98		V
				–40°C to 85°C	4.9			
			V_{OL}	25°C		0.01	0.12	
				–40°C to 85°C			0.15	
		R_L = 600 Ω to 2.5 V	V_{OH}	25°C	4.82	4.85		
				–40°C to 85°C	4.8			
			V_{OL}	25°C		0.05	0.23	
				–40°C to 85°C			0.3	
$V_{O(SD)}$	Output voltage level in shutdown mode			25°C		10	200	mV
I_{CC}	Supply current per channel	ON mode		25°C		1.17	1.7	mA
				–40°C to 85°C			1.9	
		Shutdown mode		25°C		0.12	1.5	μA
				–40°C to 85°C			2	
A_{VOL}	Large-signal voltage gain	Sourcing R_L = 10 kΩ, V_O = 2.5 V to 4.6 V		25°C	80	130		dB
				–40°C to 85°C	76			
		Sinking R_L = 10 kΩ, V_O = 0.4 V to 2.5 V		25°C	80	130		
				–40°C to 85°C	76			
		Sourcing R_L = 600 Ω, V_O = 2.5 V to 4.6 V		25°C	80	110		
				–40°C to 85°C	76			
		Sinking R_L = 600 Ω, V_O = 0.4 V to 2.5 V		25°C	80	107		
				–40°C to 85°C	76			
V_{SD}	Shutdown pin voltage	ON mode		25°C	4.5 to 5	3.5 to 5		V
		Shutdown mode			0 to 0.8	0 to 1.5		
GBWP	Gain bandwidth product			25°C		5		MHz
SR (2)	Slew rate			25°C		5		V/μs
Φ_m	Phase margin			25°C		60		°
V_n	Input referred voltage noise	f = 1 kHz		25°C		20		nV/√Hz

(1) Shorting the output to either supply rail adversely affects reliability.
(2) Number specified is the slower of the positive and negative slew rates.

Electrical Characteristics (continued)

V_{CC+} = 5 V, V_{CC-} = GND, V_{CM} = 2.5 V, and R_L > 1 MΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
$T_{(on)}$	Turn-on time from shutdown		25°C		1.6	4	µs
						4.6	

TYPICAL CHARACTERISTICS

GRAPH PREVIEWS

Supply Current per Channel vs Supply Voltage (ON Mode)

Supply Current per Channel vs Supply Voltage (Shutdown Mode)

Input Offset Voltage vs Common-Mode Voltage

Bias Current vs Common-Mode Voltage Over Temperature

Output Positive Swing vs Supply Voltage (R_L = 600 Ω)

Output Negative Swing vs Supply Voltage (R_L = 600 Ω)

Sourcing Current vs Output Voltage (V_{CC} = 2.7 V)

Sourcing Current vs Output Voltage (V_{CC} = 5 V)

Sinking Current vs Output Voltage (V_{CC} = 2.7 V)

Sinking Current vs Output Voltage (V_{CC} = 5 V)

PSRR vs Frequency (V_{CC} = 2.7 V)

PSRR vs Frequency (V_{CC} = 5 V)

CMRR vs Frequency (V_{CC} = 2.7 V)

CMRR vs Frequency (V_{CC} = 5 V)

Open-Loop Frequency Response vs R_L ($V_{CC\pm}$ = 2.7 V)

Open-Loop Frequency Response vs R_L ($V_{CC\pm}$ = 5 V)

Open-Loop Frequency Response vs C_L ($V_{CC\pm}$ = 2.7 V)

Open-Loop Frequency Response vs C_L ($V_{CC\pm}$ = 5 V)

Voltage Noise vs Frequency (V_{CC} = 2.7 V)

Voltage Noise vs Frequency (V_{CC} = 5 V)

Non-Inverting Large Signal Pulse Response (V_{CC} = 2.7 V)

Non-Inverting Large Signal Pulse Response (V_{CC} = 5 V)

Non-Inverting Small Signal Pulse Response (V_{CC} = 2.7 V)

Non-Inverting Small Signal Pulse Response (V_{CC} = 5 V)

Inverting Large Signal Pulse Response (V_{CC} = 2.7 V)

Inverting Large Signal Pulse Response (V_{CC} = 5 V)

Inverting Small Signal Pulse Response (V_{CC} = 2.7 V)

Inverting Small Signal Pulse Response (V_{CC} = 5 V)

Turn-On Response Time (V_{CC} = 5 V)

Input Common-Mode Capacitance vs Common-Mode Voltage (V_{CC} = 5 V)

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LMV712IDGSR	OBSOLETE	VSSOP	DGS	10		TBD	Call TI	Call TI	-40 to 85	RNB	
LMV712IDGSRG4	OBSOLETE	VSSOP	DGS	10		TBD	Call TI	Call TI	-40 to 85		
LMV712IDGST	OBSOLETE	VSSOP	DGS	10		TBD	Call TI	Call TI	-40 to 85	RNB	
LMV712IDGSTG4	OBSOLETE	VSSOP	DGS	10		TBD	Call TI	Call TI	-40 to 85		

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

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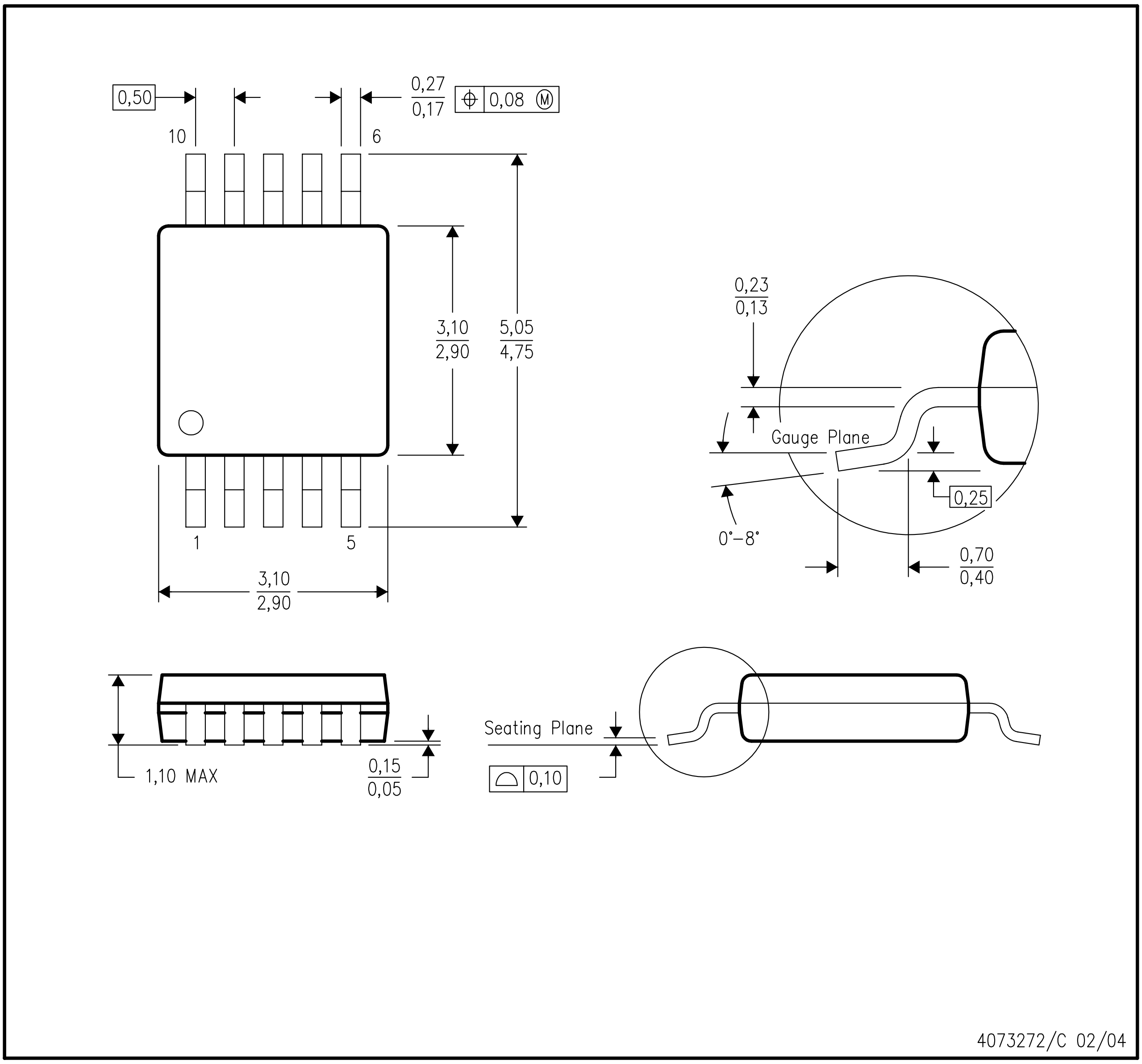
DGS (S-PDSO-G10) PLASTIC SMALL-OUTLINE PACKAGE



NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion.
- D. Falls within JEDEC MO-187 variation BA.

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