19-3929; Rev 2; 6/07

可提供评估板

2mm x 2mm µDFN封装的、128抽头非易失线性数字电位器

概述

MAX5128非易失、单组、线性数字电位器可完成机械式电位器的功能，但以简单的2线数字接口取代了机械结构。MAX5128可执行与分离式电位器或可变电阻相同的功能，具有128个抽头和22kΩ的端到端电阻。MAX5128还具有超小尺寸的2mm x 2mm µDFN封装和极低的0.5µA (典型)待机电源电流，使其用于便携式应用非常理想。MAX5128工作于+2.7V至+5.25V电源。集成非易失存储器可记忆编程设定的数字电位器滑动端位置。简单的2线上/下型控制接口用来对滑动端位置进行编程。该数字电位器具有非常低的5ppm/°C相对温度系数，能够在宽广的-40°C至+85°C温度范围内保证性能。

特性

- ♦ 超小型、2mm x 2mm、8引脚µDFN封装
- ♦ 上电后可从非易失存储器恢复滑动端位置
- ♦ 22kΩ端到端电阻
- ♦ 128个抽头位置
- ♦ 5ppm/°C相对温度系数
- ♦ 1.5µA (最大)待机电源电流
- ♦ +2.7V至+5.25V单电源工作
- ♦ 80,000次滑动端存储次数
- ♦ 50年滑动端数据保持时间

应用

LCD面板V_{COM}调节

背光调节

LED偏置调节

电源模块

光纤模块偏置设定

无线收发信机偏置设定

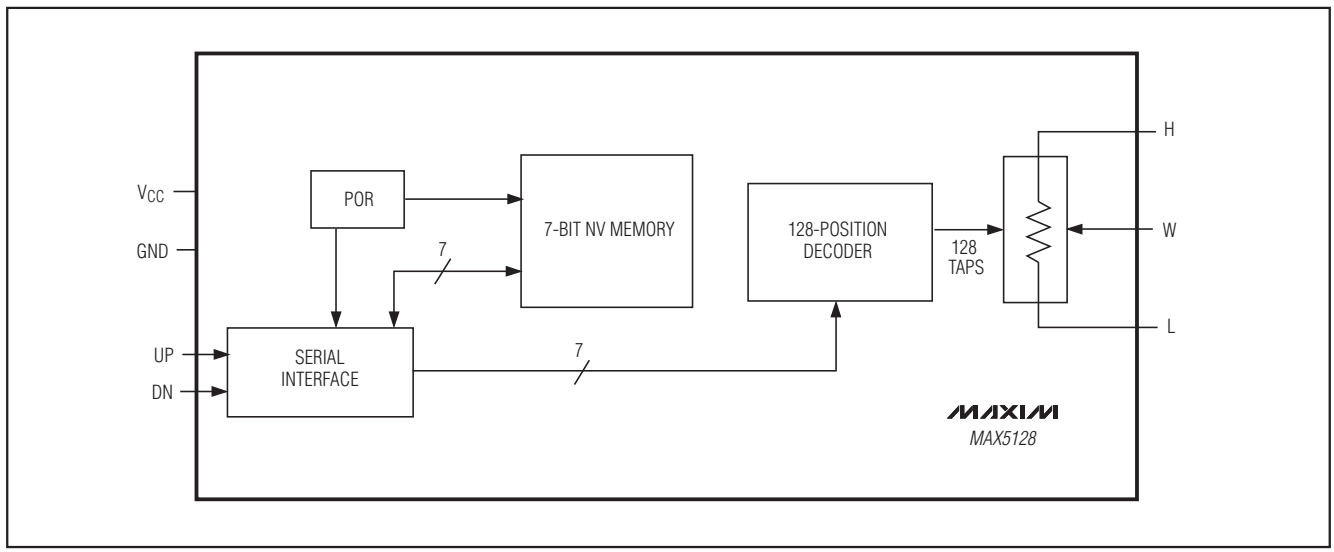
便携式消费类电子

定购信息

PART	TEMP RANGE	PIN-PACKAGE	TOP MARK	PKG CODE
MAX5128ELA+	-40°C to +85°C	8 µDFN	AAF	L822-1

+表示无铅封装。

功能框图



ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND .....-0.3V to +6.0V
UP and DN to GND .....-0.3V to (V_{CC} + 0.3V)
H, L, and W to GND.....-0.3V to (V_{CC} + 0.3V)
Maximum Continuous Current into H, L, and W .....±0.5mA
Maximum Continuous Current into All Other Pins .....±50mA
Continuous Power Dissipation (T_A = +70°C)
8-Pin µDFN (derate 4.7mW/°C above +70°C) 376.5mW
Operating Temperature Range .....-40°C to +85°C
Junction Temperature.....+150°C
Storage Temperature Range .....-60°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V_{CC} = +2.7V to +5.25V, H = V_{CC}, L = GND, T_A = -40°C to +85°C. Typical values are at V_{CC} = +5.0V, T_A = +25°C, unless otherwise noted.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DC PERFORMANCE (voltage-divider mode)						
Resolution	N		7			Bits
Integral Nonlinearity	INL	(Note 2)			±1.0	LSB
Differential Nonlinearity	DNL	(Note 2)			±1.0	LSB
End-to-End Resistance Temperature Coefficient	TC_R			50		ppm/°C
Ratiometric Resistance Temperature Coefficient				5		ppm/°C
Full-Scale Error	FSE		-3		0	LSB
Zero-Scale Error	ZSE		0		+2	LSB
DC PERFORMANCE (variable-resistor mode)						
Integral Nonlinearity	INL	(Note 3)			±1.75	LSB
Differential Nonlinearity	DNL	(Note 3)			±1	LSB
DC PERFORMANCE (resistor characteristics)						
Wiper Resistance	R_W	(Note 4)		0.6	0.8	kΩ
Wiper Capacitance	C_W			20		pF
End-to-End Resistance	R_{HL}		16	22	27	kΩ
DIGITAL INPUTS (UP, DN)						
Input-High Voltage (Note 5)	V_{IH}	3.4V ≤ V_{CC} ≤ 5.25V	2.4			V
		2.7V ≤ V_{CC} < 3.4V	0.7 x V_{CC}			
Input-Low Voltage	V_{IL}	(Note 5)			0.8	V
Input Leakage Current	I_{IN}				±1	µA
Input Capacitance	C_{IN}			5		pF
DYNAMIC CHARACTERISTICS						
Wiper -3dB Bandwidth	f_{3dB}	(Note 6)		400		kHz
THD Plus Noise	THD+N	V_H = 0.3V_{RMS}, f = 1kHz, wiper set to midscale		0.02		%

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +2.7V to +5.25V, H = V_{CC}, L = GND, T_A = -40°C to +85°C. Typical values are at V_{CC} = +5.0V, T_A = +25°C, unless otherwise noted.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
NONVOLATILE MEMORY RELIABILITY						
Data Retention		T_A = +85°C		50		Years
Endurance		T_A = +25°C		80,000		Stores
		T_A = +85°C		50,000		
POWER SUPPLY						
Supply Voltage	V_{CC}		2.70		5.25	V
Average Programming Current	I_{PG}	During nonvolatile write only; digital inputs = V_{CC} or GND		220	400	µA
Peak Programming Current	I_{PK}	During nonvolatile write only; digital inputs = V_{CC} or GND		4		mA
Standby Current	I_{CC}	Digital inputs = V_{CC} or GND, T_A = +25°C		0.5	1.5	µA

TIMING CHARACTERISTICS

(V_{CC} = +2.7V to +5.25V, H = V_{CC}, L = GND, T_A = -40°C to +85°C. Typical values are at V_{CC} = +5.0V, T_A = +25°C, unless otherwise noted.) (See Figures 1, 2, 3, and 4).

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
ANALOG SECTION						
Wiper Settling Time	t_S	(Note 7)		500		ns
DIGITAL SECTION						
UP or DN Pulse-Width High	t_{PWH}		80			ns
UP or DN Pulse-Width Low	t_{PWL}		80			ns
UP or DN Glitch Immunity	t_{IMMU}		20			ns
UP Fall to DN Rise Setup or DN Fall to UP Rise Setup	t_{MS1}		80			ns
Before Entering NVM-Write Mode, UP Fall to UP Rise	t_{MS2}		80			ns
UP Rise to DN Rise Setup when Entering NVM-Write	t_{WS}		80			ns
UP Fall to DN Fall Hold or DN Fall to UP Fall Hold during NVM-Write	t_{WH}		0			ns

TIMING CHARACTERISTICS (continued)

(V_{CC} = +2.7V to +5.25V, H = V_{CC}, L = GND, T_A = -40°C to +85°C. Typical values are at V_{CC} = +5.0V, T_A = +25°C, unless otherwise noted.) (See Figures 1, 2, 3, and 4).

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
NVM-Write Mode Pulse-Width High	t_{WP}		80			ns
Write NV Register Busy Time	t_{BUSY}				14	ms
Power-Up Settling Time	t_{ACC}	(Note 8)		2		µs

Note 1: All devices are production tested at T_A = +25°C and are guaranteed by design for T_A = -40°C to +85°C.

Note 2: The DNL and INL are measured with the potentiometer configured as a voltage-divider with H = V_{CC} and L = GND. The wiper terminal is unloaded and measured with a high input-impedance voltmeter.

Note 3: The DNL and INL are measured with the potentiometer configured as a variable resistor. H is unconnected and L = GND. For the +5V condition, the wiper terminal is driven with a source current of 200µA and for the +2.7V condition, the wiper terminal is driven with a source current of 100µA.

Note 4: The wiper resistance is measured using the source currents given in Note 3.

Note 5: The device draws higher supply current when the digital inputs are driven with voltages between (V_{CC} - 0.5V) and (GND + 0.5V). See Supply Current vs. Digital Input Voltage in the *Typical Operating Characteristics*.

Note 6: Wiper at midscale with a 10pF load, L = GND, an AC source is applied to H, and the output is measured as 3dB lower than the DC W/H value in dB.

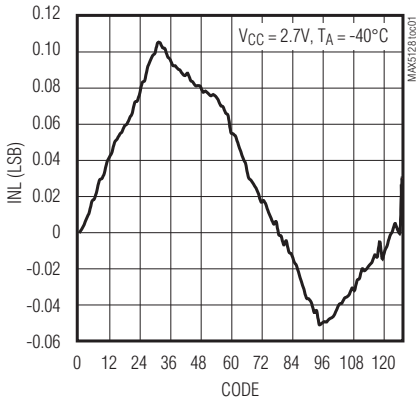
Note 7: Wiper-settling time is the worst-case 0 to 50% rise time measured between consecutive wiper positions. H = V_{CC}, L = GND, and the wiper terminal is unloaded and measured with a 10pF oscilloscope probe. See the Tap-to-Tap Switching Transient in the *Typical Operating Characteristics* section.

Note 8: Power-up settling time is measured from the time V_{CC} = 2.7V to the wiper settling to 1 LSB of the final value.

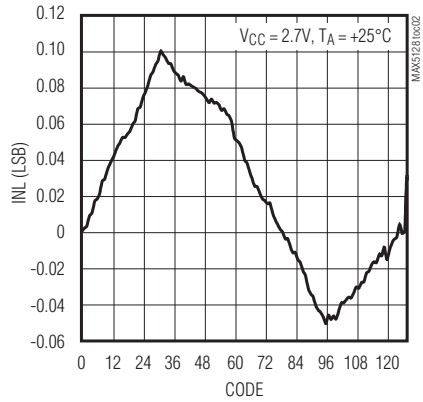
典型工作特性

(V_{CC} = +5.0V, T_A = +25°C, unless otherwise noted.)

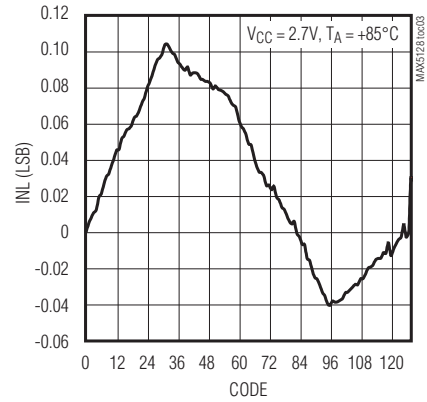
INTEGRAL NONLINEARITY vs. CODE (VOLTAGE-DIVIDER)



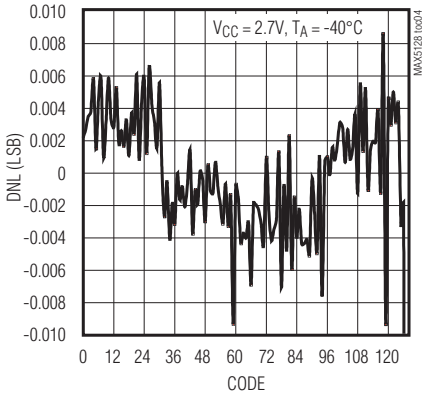
INTEGRAL NONLINEARITY vs. CODE (VOLTAGE-DIVIDER)



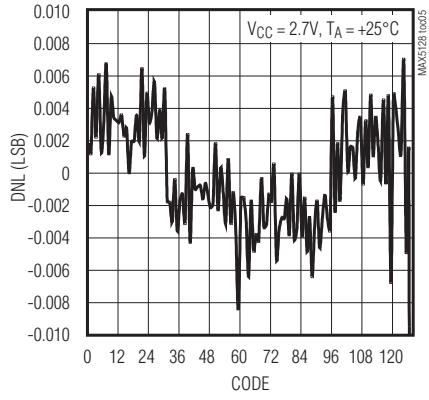
INTEGRAL NONLINEARITY vs. CODE (VOLTAGE-DIVIDER)



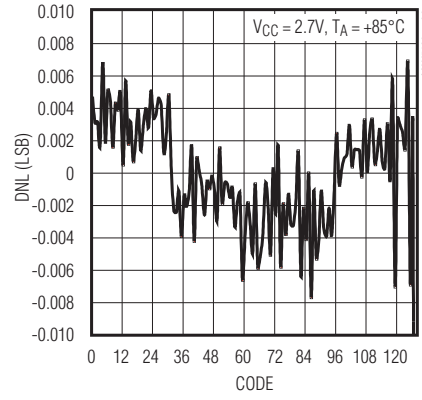
DIFFERENTIAL NONLINEARITY vs. CODE (VOLTAGE-DIVIDER)



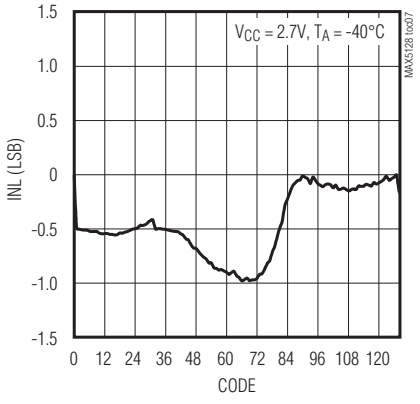
DIFFERENTIAL NONLINEARITY vs. CODE (VOLTAGE-DIVIDER)



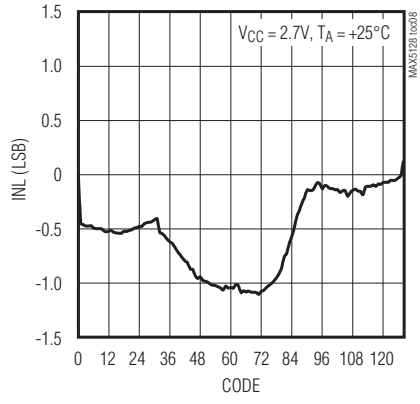
DIFFERENTIAL NONLINEARITY vs. CODE (VOLTAGE-DIVIDER)



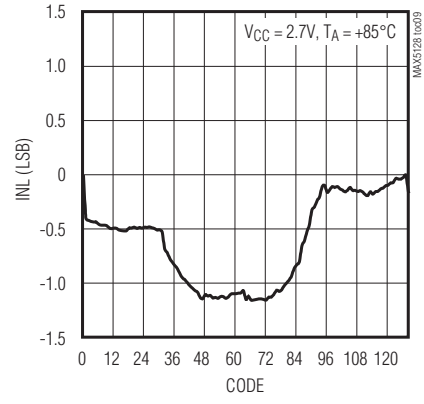
INTEGRAL NONLINEARITY vs. CODE (VARIABLE RESISTOR)



INTEGRAL NONLINEARITY vs. CODE (VARIABLE RESISTOR)



INTEGRAL NONLINEARITY vs. CODE (VARIABLE RESISTOR)

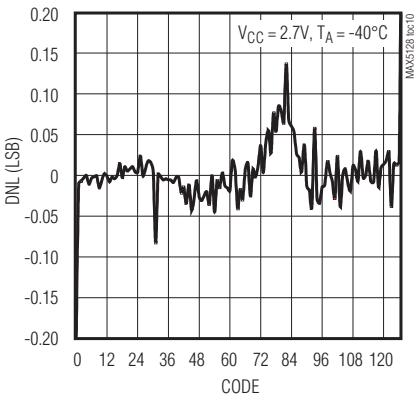


2mm x 2mm μDFN封装的、128抽头非易失线性数字电位器

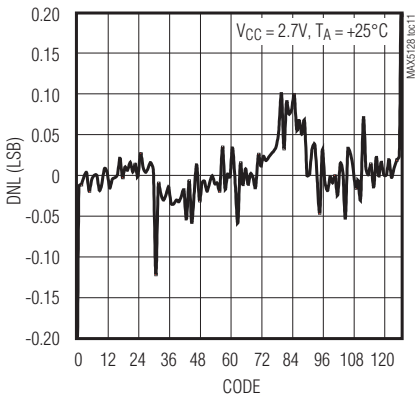
典型工作特性(续)

(V_{CC} = +5.0V, T_A = +25°C, unless otherwise noted.)

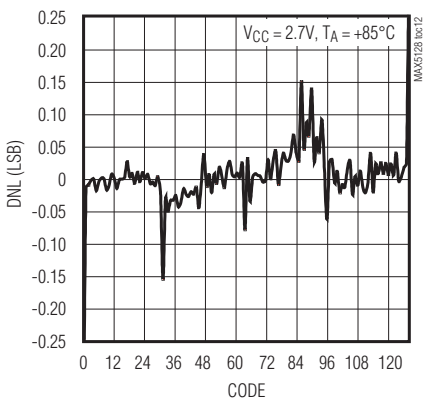
DIFFERENTIAL NONLINEARITY vs. CODE (VARIABLE RESISTOR)



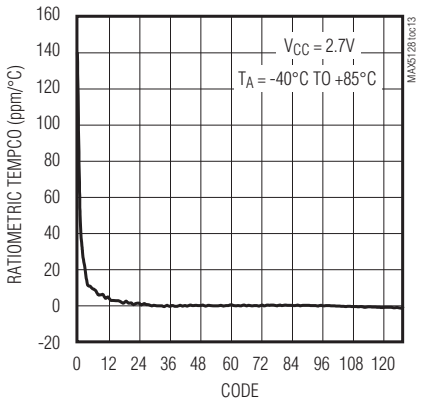
DIFFERENTIAL NONLINEARITY vs. CODE (VARIABLE RESISTOR)



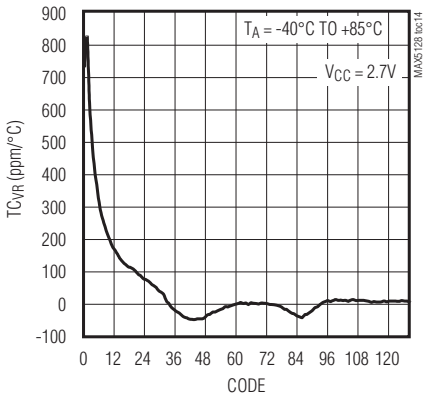
DIFFERENTIAL NONLINEARITY vs. CODE (VARIABLE RESISTOR)



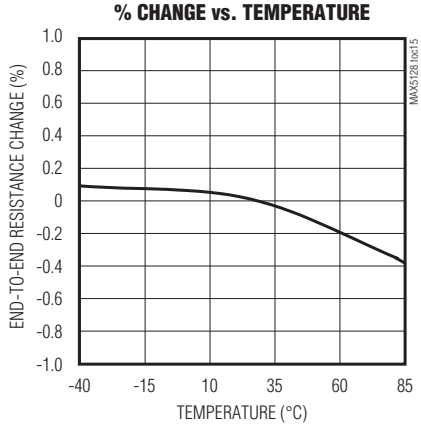
RATIOMETRIC TEMPERATURE COEFFICIENT vs. CODE (VOLTAGE-DIVIDER)



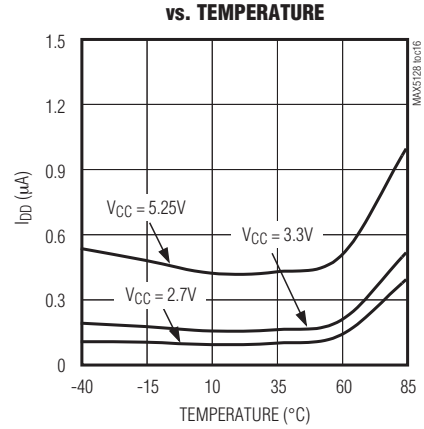
TEMPERATURE COEFFICIENT vs. CODE (VARIABLE RESISTOR)



END-TO-END RESISTANCE (R_{HL}) % CHANGE vs. TEMPERATURE



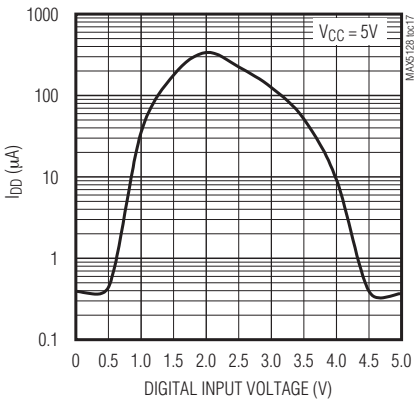
STANDBY SUPPLY CURRENT vs. TEMPERATURE



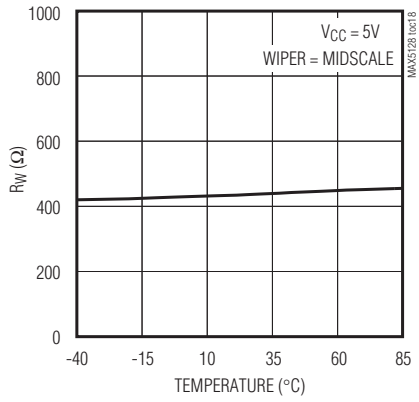
典型工作特性(续)

(V_{CC} = +5.0V, T_A = +25°C, unless otherwise noted.)

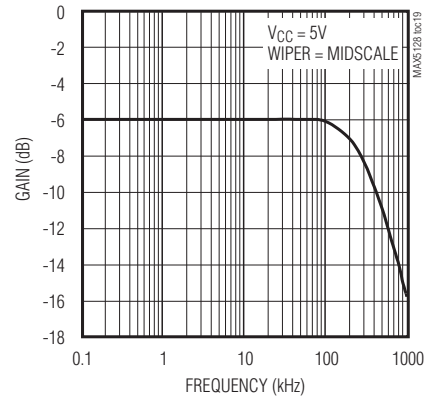
SUPPLY CURRENT vs. DIGITAL INPUT VOLTAGE



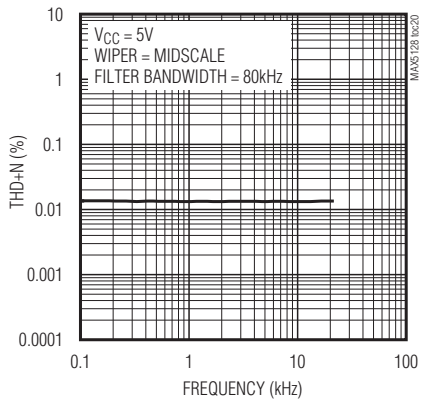
WIPER RESISTANCE vs. TEMPERATURE



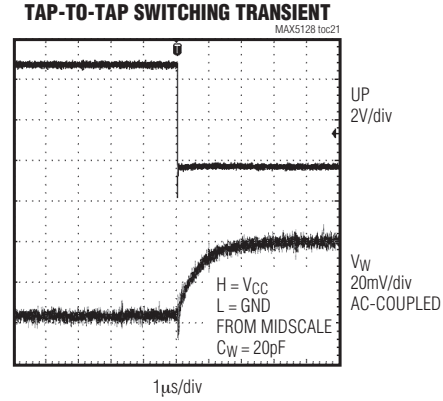
WIPER RESPONSE vs. FREQUENCY



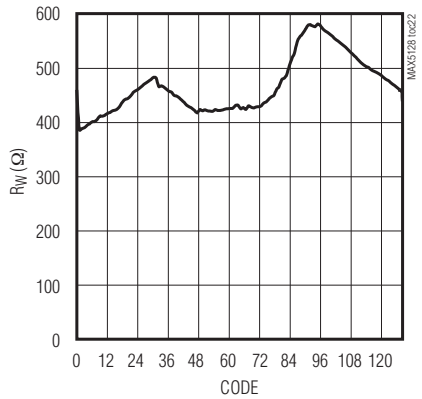
THD+N vs. FREQUENCY



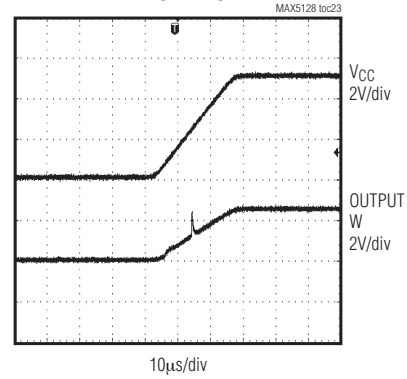
TAP-TO-TAP SWITCHING TRANSIENT



WIPER RESISTANCE vs. CODE



MIDSCALE WIPER TRANSIENT AT POWER-ON



2mm x 2mm μDFN封装的、128抽头非易失线性数字电位器

引脚说明

引脚	名称	功能
1	V_{CC}	电源。用0.1μF电容尽量靠近器件旁路V_{CC}到GND。为确保正常工作，应限制电源电压摆率≥ 10μs。
2	H	电位器高端。H端电压可高于或低于L端电压。电流既可流入，也可流出H。
3	W	滑动端。
4	L	电位器低端。L端电压可高于或低于H端电压。电流既可流入，也可流出L。
5	GND	地。
6	DN	下调输入。
7	UP	上调输入。
8	N.C.	不连接，没有内部连接。

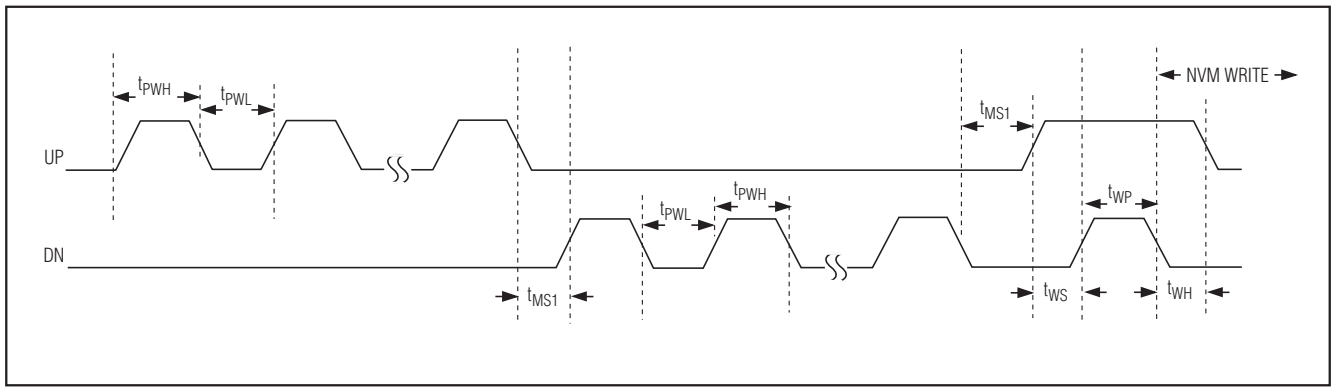


图1. 数字接口时序图

详细说明

MAX5128非易失、单组、线性数字电位器可完成机械式电位器或可变电阻的功能，但以简单的2线数字接口取代了机械结构。该器件具有128个分级和22kΩ的端到端电阻，相对温度系数仅有5ppm/°C。MAX5128工作于+2.7V至+5.25V电源，仅消耗0.5μA (典型)的待机电源电流。MAX5128包含集成的非易失存储器，可用来记忆数字电位器的滑动端位置。通过简单的2线上/下型控制接口可以编程设置滑动端的位置。

模拟电路

MAX5128含有一个由127只电阻元件组成的电阻串；该电阻串两个端点为H和L，它们之间共128个抽头点，可有选择地通过滑动端W引出。通过2线接口(UP，DN)对电位器进行编程，可以选择哪个抽头点由滑动端引出。

MAX5128有一个上电复位电路，上电之后它可以由非易失存储器载入滑动端的位置。

出厂时，非易失存储器被编程于中点位置。

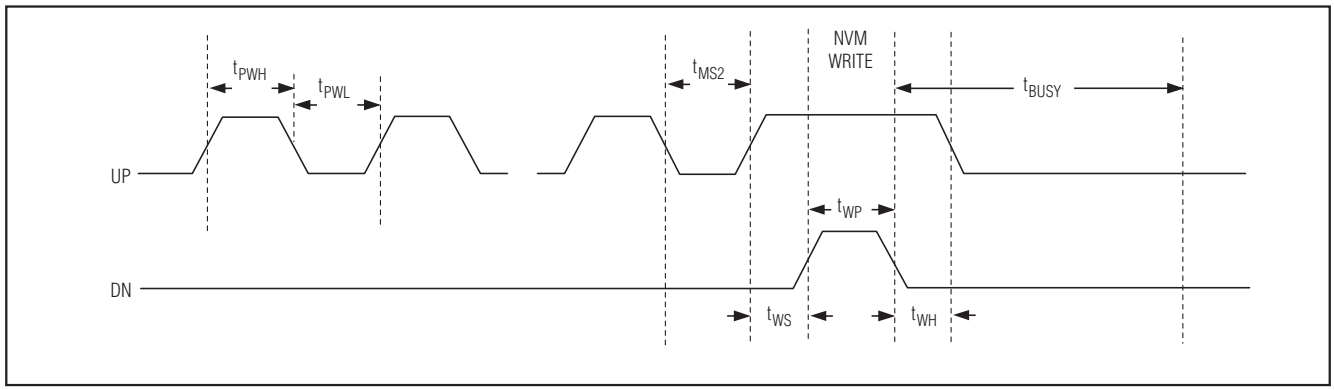


图2. 数字接口时序：t_{BUSY}

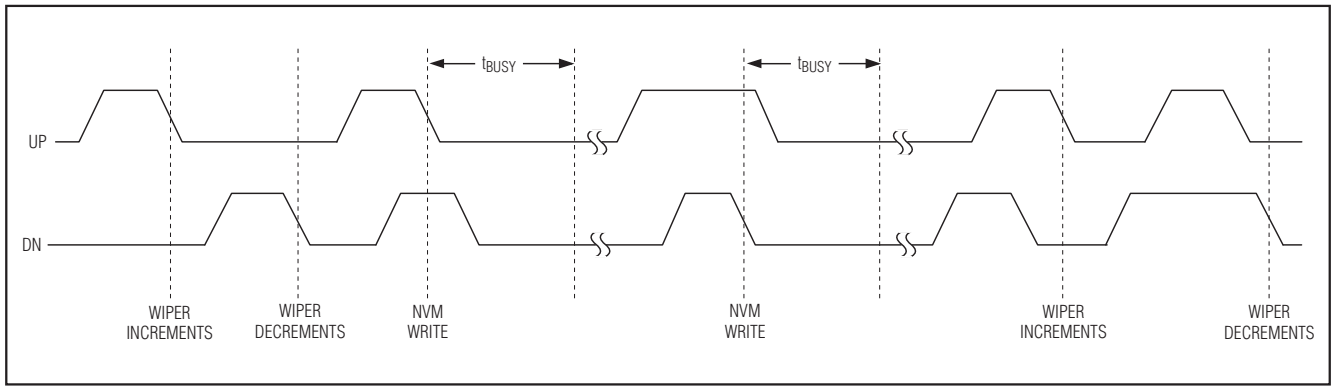


图3. 数字接口命令

数字接口

MAX5128采用由两个逻辑输入(UP和DN)组成的2线接口进行控制。通过逻辑输入UP和DN可以控制滑动端位置，并将位置信息写入非易失存储器。DN为低，UP由高变低可使滑动端位置递增。UP为低，DN由高跳低可使滑动端位置递减(见图1、2和3)。当滑动端递减时，其W和L间的电阻减小(H和W间的电阻增加)。

要编程非易失存储器，可先拉高UP，再拉高DN，然后使两输入(UP/DN)由高变低(见图3)。

滑动端位置以“先合后开”方式转换，保证在从一个电阻抽头转换到另一抽头时不会发生开路情况。当到达电阻串的任何一个端点 (最大/最小) 时，滑动端不回转。若继续发送跳变命令使其向同一端点移动，则抽头位置不会改变。

这些控制逻辑输入对于短脉冲干扰不敏感(20ns)，滑动端位置不会因短脉冲干扰而改变(见图4)。

写非易失寄存器

内部EEPROM由一个7位宽的非易失存储单元组成，能够在掉电后保持写入其中的数据。要编程这个非易失存储器，可先拉高UP，再拉高DN，然后再使这两个输入(UP/DN)由高变低。写非易失存储器需要14ms (最大)的时间。这段时间内，新的非易失写命名或者递增或递减滑动端位置的命令均被忽略。上电之初，滑动端会自动恢复到非易失寄存器所保存的位置。MAX5128在出厂时滑动端被设置在中点。

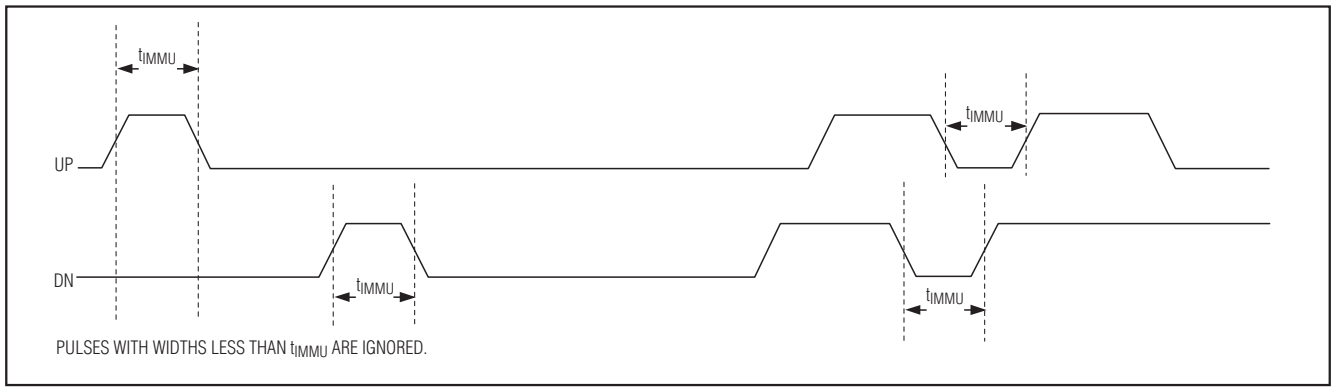


图4. 时序逻辑对短脉冲不敏感

待机模式

串行接口上没有信号时MAX5128工作于待机模式。对MAX5128进行编程时平均工作电流增加至400µA (最大)。待机模式下静态电源电流降至0.5µA (典型)以下。

上电

上电之初，MAX5128用非易失存储器中保存的数据初始化滑动端位置。该初始化过程需2µs (典型)。为确保正常工作，应将电源电压摆率限制于≥ 10µs。

应用信息

MAX5128可以用于那些需要以数字方式调节电阻或电压的应用，例如LCD对比度控制(通过偏压调节显示对比度)，或具有可调输出的DC-DC转换器。22kΩ端到端电阻被分为128个引出点，各点之间的间隔172Ω。MAX5128可用在分压器或可变电阻配置中。

V_{COM}发生器

图5显示了一个利用MAX4238和MAX5128产生LCD面板所需V_{COM}电压的应用。调节MAX5128的电阻值可改变V_{COM}电压。调节V_{COM}电压可改变LCD面板的对比度。

DC-DC转换器应用

图6和7显示了两种利用MAX5128调节DC-DC转换器输出电压的应用。图6中MAX5128电位器的一端是接地的。而图7中MAX5128电位器是悬浮的。电位器接地时，迫使DC-DC转换器的输出电压只能在MAX5128的电源电压范围内变化。电位器悬浮时，DC-DC转换器的输出电压可超出MAX5128的电源范围。悬浮电位器结构增大了输出电压的调节范围，并提高了输出电压调节范围的精度。

LED偏置调节

图8显示了MAX5128在LED偏置调节中的应用，用它来设定MAX1574驱动LED的电流。在该电路中，MAX5128在10mA至60mA范围内调节LED驱动电流。

芯片信息

PROCESS: BiCMOS

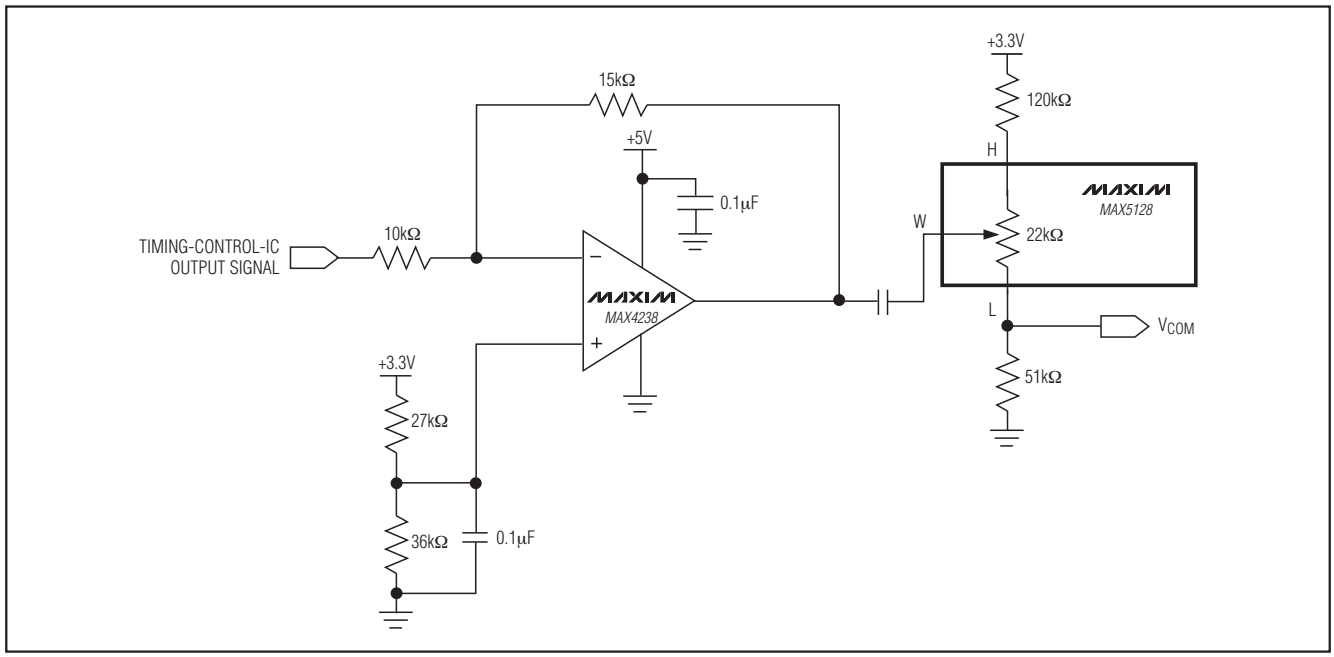


图5. 用于LCD面板的V_{COM}发生电路

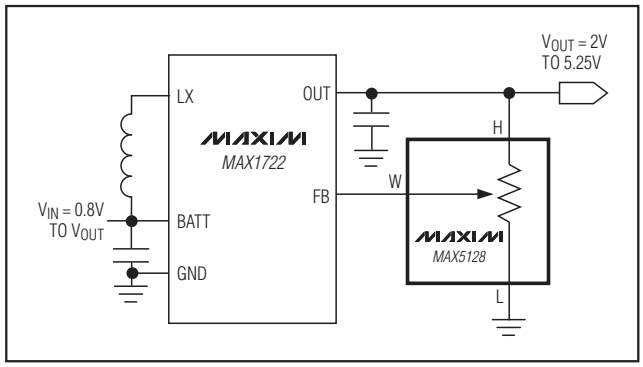


图6. DC-DC转换器中使用接地电位器

2mm x 2mm μDFN封装的、128抽头非易失线性数字电位器

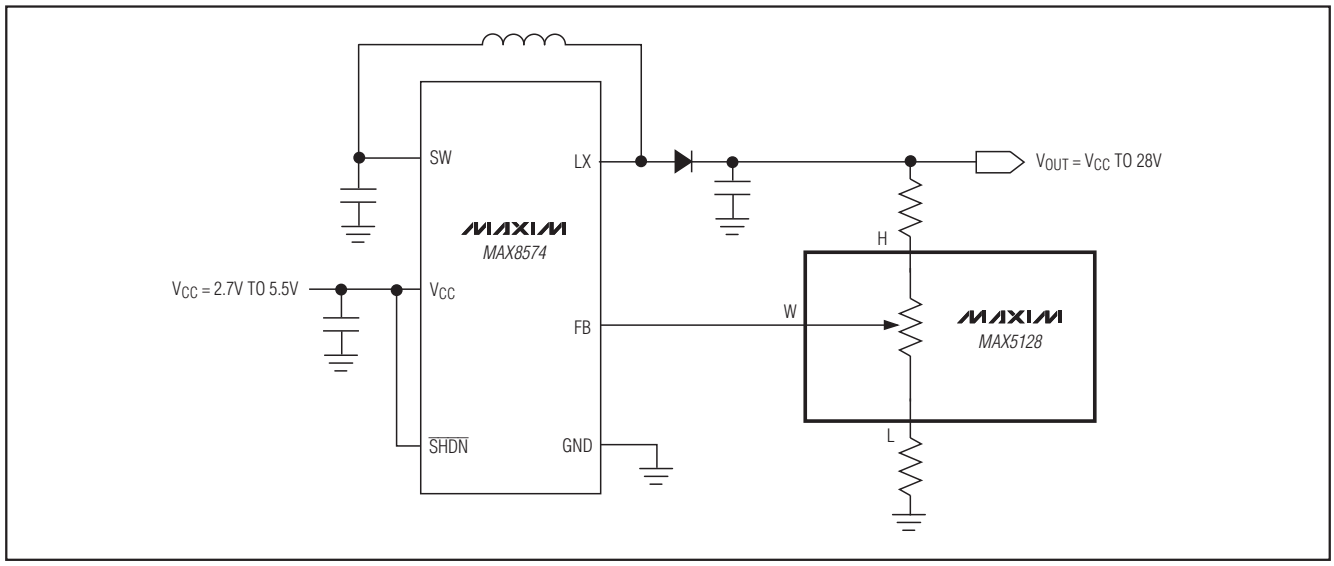


图7. DC-DC转换器中使用悬浮电位器

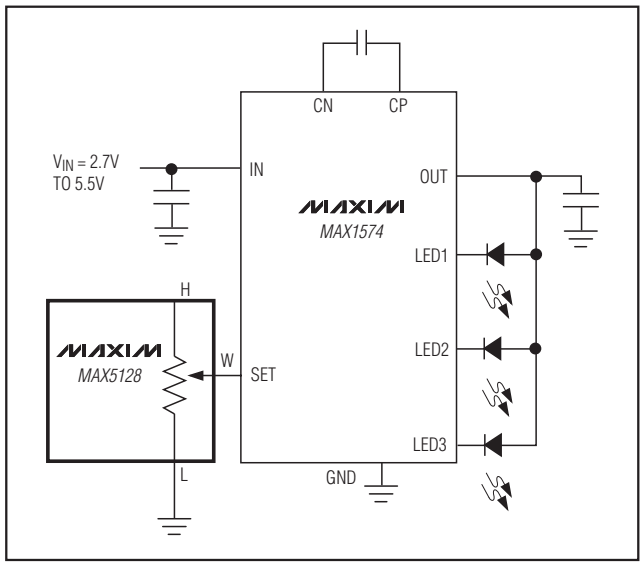
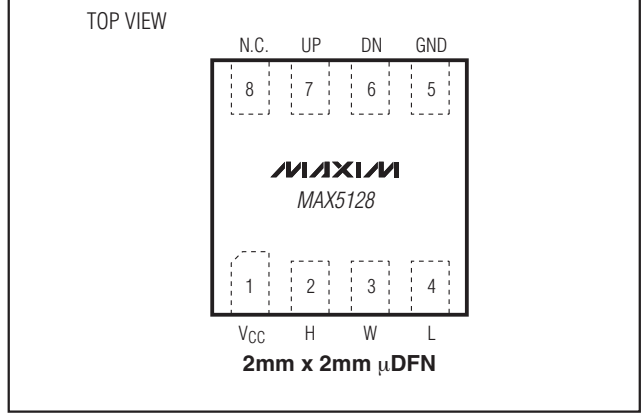


图8. 利用MAX5128调节LED偏置

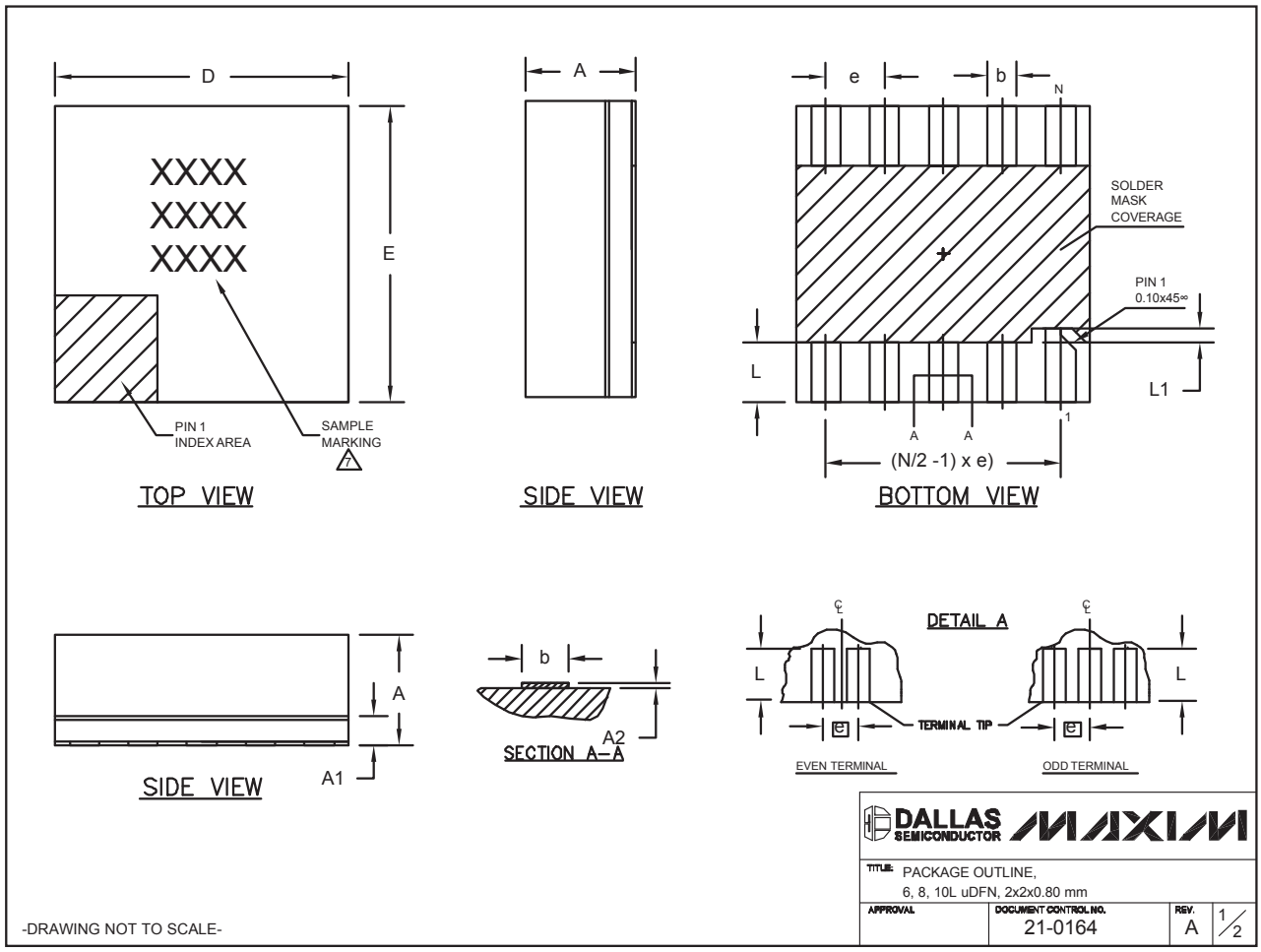
引脚配置



封装信息

(本数据资料提供的封装图可能不是最近的规格，如需最近的封装外形信息，请查询 **www.maxim-ic.com.cn/packages**。)

6, 8, 10L UDFN.EPS



2mm x 2mm µDFN封装的、128抽头非易失线性数字电位器

封装信息(续)

(本数据资料提供的封装图可能不是最近的规格，如需最近的封装外形信息，请查询 **www.maxim-ic.com.cn/packages**。)

COMMON DIMENSIONS			
SYMBOL	MIN.	NOM.	MAX.
A	0.70	0.75	0.80
A1	0.15	0.20	0.25
A2	0.020	0.025	0.035
D	1.95	2.00	2.05
E	1.95	2.00	2.05
L	0.30	0.40	0.50
L1	0.10 REF.		

PACKAGE VARIATIONS				
PKG. CODE	N	e	b	(N/2 -1) x e
L622-1	6	0.65 BSC	0.30±0.05	1.30 REF.
L822-1	8	0.50 BSC	0.25±0.05	1.50 REF.
L1022-1	10	0.40 BSC	0.20±0.03	1.60 REF.

NOTES:
1. ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.
2. COPLANARITY SHALL NOT EXCEED 0.08mm.
3. WARPAGE SHALL NOT EXCEED 0.10mm.
4. PACKAGE LENGTH/PACKAGE WIDTH ARE CONSIDERED AS SPECIAL CHARACTERISTIC(S).
5. "N" IS THE TOTAL NUMBER OF LEADS.
6. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY.
7. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.

-DRAWING NOT TO SCALE-

DALLAS SEMICONDUCTOR MAXIM

TITLE: PACKAGE OUTLINE, 6, 8, 10L uDFN, 2x2x0.80 mm

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0164	A	2/2

修订历史

Rev 1中的修改页：1、9、10、13。

Rev 2中的修改页：1、9–14。

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