LinearDimensions SEMICONDUCTOR

MEMsics™ with nanoPower Technology

LND1114

Programmable Fourteen (14) Channel High Voltage Precision Voltage Reference

GENERAL DESCRIPTION

The LND1114-1, -2, -3 are the smallest fourteen (14) channel voltage references available. The LND1114-1, -2, -3 combine extremely high accuracy with high voltage capability. Each reference voltage may be independently programmed or factory pre-set to any voltage from 100mV to 9V. The LND1114-1 offers 5mV accuracy, the LND1114-2 offers 1mV accuracy, LND1114-3 offers 0.5mV accuracy.

The LND1114 uses Linear Dimensions proprietary floating gate technology to produce a flat response over temperature, eliminating the curved temperature profile normally associated with bandgap based silicon references and dramatically improves accuracy. The technology has been proven to maintain a +/-2% worst case accuracy **over 10 years at 70C.**

The LND1114 is packaged in a compact 2.2x3mm, 18 lead QFN package.

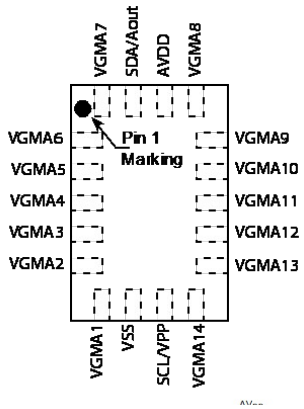
APPLICATIONS

- Instrumentation
- Precision DAC Replacement
- Sensor Calibration
- Transceivers & Interfaces
- Optical Laser Drivers
- Precision Portable Instrumentation

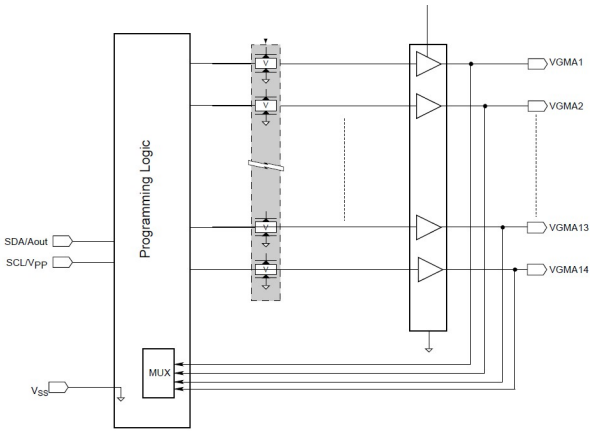
FEATURES

- Fourteen (14) Precision Voltage References
- Wide Input Voltage Range: 2.7V to 12V
- Each Voltage Reference May be Independently Programmed from 0.1V to 9V
- Available Pre-Programmed
- Quiescent Current: 39uA/Channel
- Buffered Outputs: +/-1.5mA Per Channel
- High Precision:
  - Eliminates Silicon Bandgap Curvature
  - Initial Accuracy of 5mV, 1mV or 0.5mV (LND1114-1, LND1114-2, LND1114-3)
- Super Flat Response
- ~13uV Variation @ 70C **Over 10 Years**
- Super Small 3x2.2mm QFN Package

PINOUT



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Over operating free-air temperature range unless otherwise specified [1]

PARAMETER	Max	Unit
Analog Supply, A_{VDD} [2]	13	V
Programming Supply V_{PP}	14	V
Maximum Junction Temperature, T_J	150	ºC
Storage Temperature, T_{STG}	-65 to 150	ºC

- 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.
- All voltage values are with respect to V_{SS}.

DISSIPATION RATING TABLE

PACKAGE TYPE	PACKAGE DESIGNATOR	Θ_{JA}
QFN 18	Q	59ºC/W

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Units
T_A	Operating Free air Temperature	-5		85	ºC
A_{VDD}	Analog Supply Voltage (2)	2.7		12	V
V_{PP}	Programming Supply Voltage (2)	9		14	V

ELECTRICAL CHARACTERISTICS

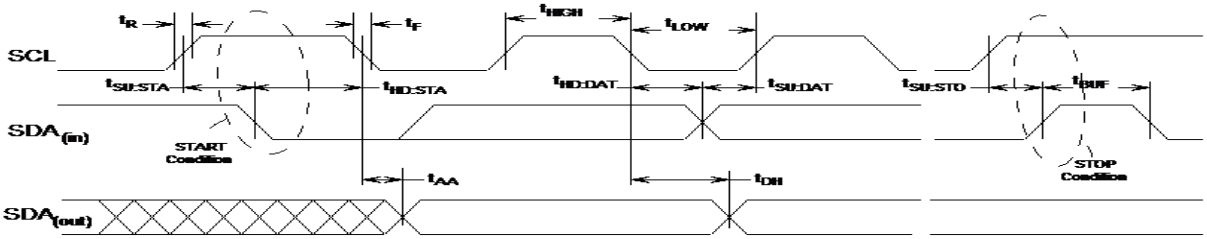
Operating temperature range -5 to 85ºC, V_{PP} = 9V to 14V, A_{VDD} = 9V unless otherwise specified.

SUPPLIES						
Symbol	**Parameter**	**Test Condition**	**Min**	**Typ**	**Max**	**Units**
I_{AVDD}	Analog Supply Current	A_{VDD} = 3.3V		545		uA
I_{AVDD}	Analog Supply Current	A_{VDD} = 5.0V		600		uA
I_{AVDD}	Analog Supply Current	A_{VDD} = 9V		650		uA
ANALOG CHARACTERISTICS						
Symbol	**Parameter**	**Test Condition**	**Min**	**Typ**	**Max**	**Units**
V_{PROG}	Voltage Operating Range		2.7		9	V
V_{PROG}	V_{REF} Programming Precision	LD1114-1		±5		mV
V_{PROG}	V_{REF} Programming Precision	LD1114-2		±1		mV

V_{PROG}	V_{REF} Programming Precision	LD1114-3		±0.5		mV
OL_{DRIFT}	Operating Life V_{REF} Drift	10 Years @ 70ºC, Vo=5V	-0.2		+0.2	%
I_{OUT}	Current Per V_{REF} Output	A_{VDD} = 5.0V	-1.5		+1.5	mA
V_{OL}	V_{REF1} & V_{REF2} Output Swing Low	I Sink 50 uA	V_{SS}+0.1			V
V_{OH}	V_{REF13} & V_{REF14} Output Swing High	I source 50 uA			A_{VDD}-0.1	V
V_{TEMP}	Output voltage Variation with temperature	Δ V_{REF} for temperature from -5 to 85 deg. C	-0.2		+0.1	%
PSRR	Power Supply Rejection Ratio	Δ V_{REF} for 6V ≤ AVDD ≤ 9V	45	60		dB

Digital OPERATING CHARACTERISTICS						
Symbol	**Parameter**	**Test Condition**	**Min**	**Typ**	**Max**	**Units**
V_{IL}	SDA, Input Low Voltage				V_{CC}x.20	V
V_{IH}	SDA, Input High Voltage		V_{CC}x.80			V
V_{OL}	SDA, Low voltage Output				2	V

Note: Detailed programming information is available from Linear Dimensions in the LND1114 Addendum.



Serial Interface Timing Diagram

(Over recommended operating conditions, unless otherwise noted. All voltages are relative to V_{SS}.)

Symbol	**Description**	**Min.**	**Typ.**	**Max.**	**Units**
f_{SCL}	**SCL Clock Frequency**	**0**		**100**	**KHz**
t_{LOW}	**Clock Low Period**	**4.7**			**µs**
t_{HIGH}	**Clock High Period**	**4.0**			**µs**
t_{BUF}	**Bus Free Time**	**4.7**			**µs**
$t_{SU:STA}$	**Start Condition Setup Time**	**4.7**			**µs**
$t_{HD:STA}$	**Start Condition Hold Time**	**4.0**			**µs**

$t_{SU:STO}$	**Stop Condition Setup Time**	**4.7**			**µs**
t_{AA}	**Clock Edge to Data Valid**	**0.1**		**4.5**	**µs**
t_{DH}	**Data Output Hold Time**	**100**			**nsec**
t_R	**SCL and SDA Rise Time**			**1**	**µs**
t_F	**SCL and SDA Fall Time**			**300**	**nsec**
$t_{SU:DAT}$	**Data In Setup Time**	**200**			**nsec**
$t_{HD:DAT}$	**Data In Hold Time**	**0**			**nsec**
TI	**Noise Filter SCL and SDA**			**100**	**nsec**

FUNCTIONAL DESCRIPTION

The **LND1114** is a programmable voltage reference device.

The **LND1114** has 14 voltage reference outputs (VREF1-VREF14). Each voltage is programmed as a difference between two analog nonvolatile memory cells. Storing the voltage in a pseudo-differential manner provides excellent temperature stability as well as supply rejection.

SDA/ A_{OUT} is a dual function Pin**.**

SDA is the serial data input pin used to input instructions and data into the LND1114.

A_{OUT} is an un-buffered analog output that reflects the V_{REF} voltage of the output being programmed.

SCL/V_{PP} is a dual function pin.

SCL is the serial clock that is used to clock data into or out of the device on the Serial Data line.

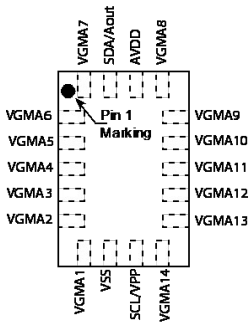
V_{PP} is a high voltage input which is used top program gamma voltages to their desired values.

VOLTAGE PROGRAMMING

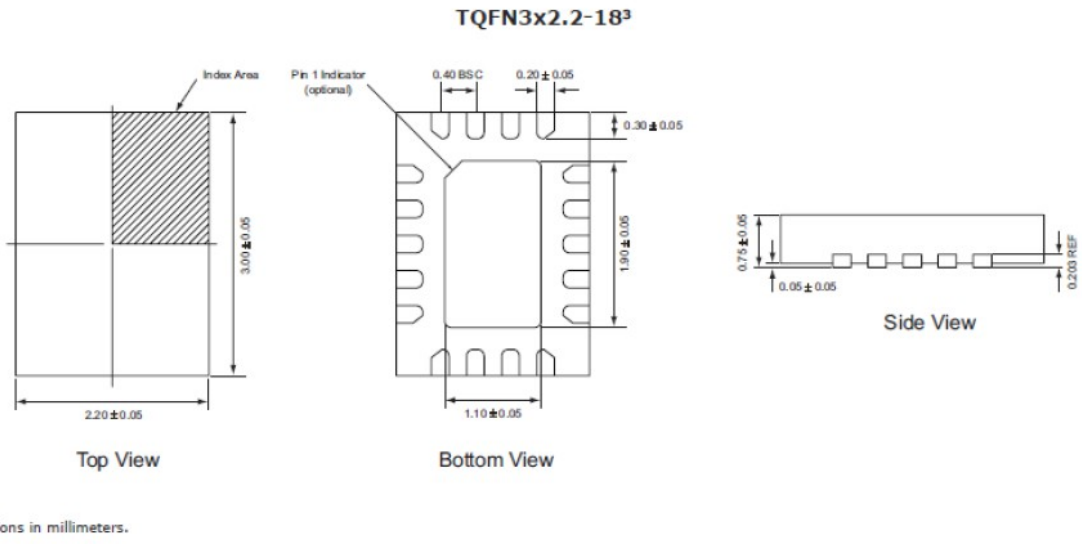
Programming the voltage reference voltages is generally done utilizing the AP100 programmer, however, in circuit programming is also possible. Programming of the references utilizes the SDA pin as a command/data input, used to select the function to perform and to select the gamma output (V_{REF1} – V_{REF14}) to be programmed. The SDA pin also outputs the actual voltage on the output pin of the reference voltage being programmed. The SCL/VPP input provides the clock for inputting data and the programming voltage for the non-volatile analog storage cells.

Programming details are available from Linear Dimensions for those wishing to perform in circuit programming, however, factory presets are recommended and can be defined during the ordering process.

PACKAGE



The LND1114 is packaged in a 2.2x3mm TQFN package offering minimal footprint and headroom for size challenged applications. It is the only fourteen (14) channel voltage reference in such a small package.



All dimensions in millimeters.

PINOUT

INPUT / OUTPUT FUNCTION DESCRIPTION			
Name	**Description**	**Value Range**	**Function**
V_{SS}	Ground		Ground for both analog and digital circuitry
A_{VDD}	Analog Supply	2.7V-12V	Analog Input Voltage
V_{REF1}- V_{REF14}	Analog Outputs	V_{SS}+0.1 to A_{VDD}-0.1	Voltage references
SDA/Aout	Serial I/O	V_{IL} to V_{IH}	Serial data interface used during the programming of the LND1114 **Programming:** During voltage reference programming, the A_{OUT} signal provides a closed loop measurement of the voltage reference voltage being programmed.
SCL/VPP	Serial clock Input Programming Voltage	V_{IL} to V_{IH} 9V to 14V	Serial clock interface used during the programming of the LND1114 **Programming:** Input for VPP pulses for adjusting the VREF output values and VPP for Programming memory cells.