MAX20331 High-Voltage Protection 3.5mm Audio Line OVP

General Description

The MAX20331/MAX20331A are overvoltage ICs designed to protect the audio codecs and electronics of portable devices. Connecting the MAX20331/MAX20331A between the 3.5mm jack and audio path electronics provides protection against high-voltage conditions to ±40V.

The MAX20331/MAX20331A are available in a space-saving, 9-bump, 0.4mm pitch, 1.23mm x 1.23mm wafer-level package (WLP) and operate over the -40°C to +85°C extended temperature range.

Applications

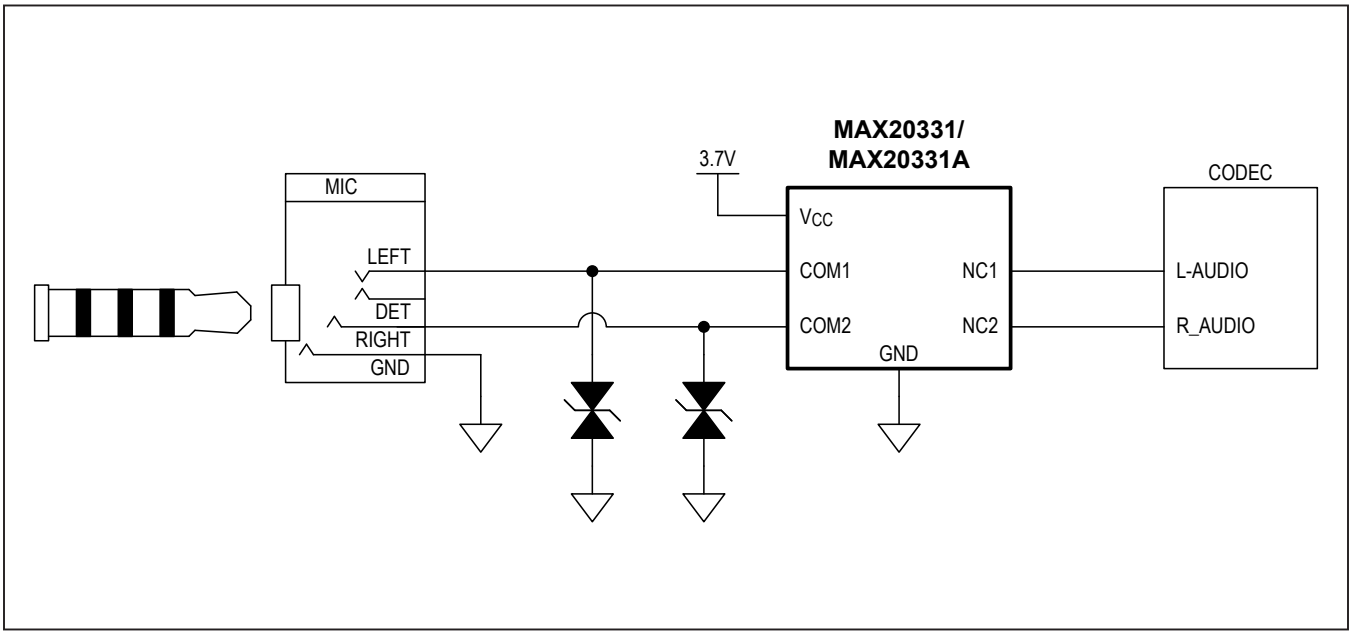
- Smartphones
- Tablets

Benefits and Features

- Protects Devices from High-Voltage Conditions
  - ±40V Tolerant Inputs
- Multiple OVP Thresholds for Flexible Design
  - ±3.45V MAX20331, ±5.5V MAX20331A
- Low THD+N Preserves Audio Clarity
- Saves Board Space with Small Form Factor
  - 1.23mm x 1.23mm, 3 x 3 Array, 9-Bump, 0.4mm Pitch WLP

***Ordering Information** appears at end of data sheet.*

Typical Application Circuit



19-100328; Rev 0; 6/18

Absolute Maximum Ratings

All voltages are referenced to GND unless otherwise noted.
V_{CC}.....-0.3V to +6V
COM_ .....-40V to +40V
VN.....-40V to +0.3V
NC_ .....-6V to +6V
COM_ to NC_.....-40V to +40V
|COM1 - COM2| .....+40V
Continuous Current into Device 0.75A
Peak Current (10ms).....2A
Continuous Power Dissipation (Multilayer Board)
(derate 11.91mW/°C above +70°C).....952.8mW
Operating Temperature Range..... -40°C to +85°C
Junction Temperature.....+150°C
Storage Temperature Range..... -65°C to +150°C
Soldering Temperature (reflow).....+260°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.

Package Information

PACKAGE TYPE: 9 WLP	
Package Code	W91F1+1
Outline Number	**21-100234**
Land Pattern Number	Refer to **Application Note 1891**
THERMAL RESISTANCE, FOUR-LAYER BOARD	
Junction to Ambient (θ_{JA})	83.98°C/W

For the latest package outline information and land patterns (footprints), go to **www.maximintegrated.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to **www.maximintegrated.com/thermal-tutorial**.

Electrical Characteristics

(V_{CC} = 2.5V to 5.5V, T_A = -40°C to +85°C unless otherwise noted. Typical values are at V_{CC} = +2.5V, T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
POWER SUPPLY							
Supply Voltage Range	V_{CC}	MAX20331		1.6		5.5	V
		MAX20331A		2.5		5.5	
Supply Current	I_{CC}				85	160	µA
COM1, COM2, NC1, NC2							
COM_ Positive Overvoltage Trip Threshold	V_{OVLO_P}	MAX20331	$V_{COM_}$ rising	3.3	3.45	3.6	V
			$V_{COM_}$ falling	3.22			
		MAX20331A	$V_{COM_}$ rising	5.35	5.5	5.65	
			$V_{COM_}$ falling	5.25			
COM_ Negative Overvoltage Trip Threshold	V_{OVLO_N}	MAX20331	$V_{COM_}$ falling	-3.3	-3.45	-3.6	V
			$V_{COM_}$ rising	-3.22			
		MAX20331A	$V_{COM_}$ falling	-5.35	-5.5	-5.65	
			$V_{COM_}$ rising	-5.25			

Electrical Characteristics (continued)

(V_{CC} = 2.5V to 5.5V, T_A = -40°C to +85°C unless otherwise noted. Typical values are at V_{CC} = +2.5V, T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
COM_ Off Leakage Current	I_{COM_OFF}	V_{CC} = 0V, $V_{COM_}$ = -6V, +6V, $V_{NC_}$ = 0V		-1		+1	µA
COM_ On Leakage Current	I_{COM_ON}	MAX20331	V_{CC} = 3V, $V_{COM_}$ = -3V, +3V, NC_ floating	-1		+1	µA
		MAX20331A	V_{CC} = 3V, $V_{COM_}$ = -5V, +5V, NC_ floating	-1		+1	
NC_ Off Leakage Current	I_{NC_OFF}	V_{CC} = 0V, $V_{NC_}$ = -6V, +6V, $V_{COM_}$ = 0V		-1		+1	µA
TIMING CHARACTERISTICS (FIGURE 1)							
COM_ Positive Overvoltage Fault Protection Response Time	t_{FP}	$V_{COM_}$ = 1V to 10V step, V_{CC} = 3.0V, $R_{NC_}$ = 1kΩ			1.2		µs
COM_ Positive Overvoltage Fault Protection Recovery Time	t_{FPR}	$V_{COM_}$ = 10V to 1V step, V_{CC} = 3.0V, $R_{NC_}$ = 1kΩ			120		µs
COM_ Negative Overvoltage Fault Protection Response Time	t_{FN}	$V_{COM_}$ = -1V to -10V step, V_{CC} = 3.0V, $R_{NC_}$ = 1kΩ			1.8		µs
COM_ Negative Overvoltage Fault Protection Recovery Time	t_{FNR}	$V_{COM_}$ = -10V to -1V step, V_{CC} = 3.0V, $R_{NC_}$ = 1kΩ			120		µs
SWITCH CHARACTERISTICS							
Analog Switch Range		MAX20331		-3.6		3.6	V
		MAX20331A		-5.65		5.65	
On-Resistance (COM_ to NC_)	R_{ON}	$I_{COM_}$ = 100mA			1	1.6	Ω
On-Capacitance		-3.3V < $V_{NC_}$ < +3.3V			18		pF
On-Resistance Match Between Channels	ΔR_{ON}	V_{CC} = 3.3V, $I_{COM_}$ = 100mA, $V_{COM_}$ = -1V to +1V (Note 2)			0.001	0.05	Ω
On-Resistance Flatness	R_{FLAT}	V_{CC} = 3.3V, $I_{COM_}$ = 100mA, $V_{COM_}$ = -1V to +1V (Note 3)			0.0001	0.015	Ω
PSRR		f = 20kHz, $V_{COM_}$ = 0.4V_{Pk-Pk}			-60		dB
Bandwidth	BW	$V_{COM_}$ = 0.4V_{Pk-Pk}, RS = RL = 50Ω			350		MHz
Off-Isolation	V_{ISO}	f = 20kHz, $V_{COM_}$ = 0.4V_{Pk-Pk}, R_L = 50Ω			-70		dB
Crosstalk	V_{CT}	f = 20kHz, $V_{COM_}$ = 0.4V_{Pk-Pk}, R_L = 50Ω			-70		dB
THD+N		f = 20Hz to 20kHz, $V_{COM_}$ = 1V_{Pk-Pk}, DC bias = 0V, R_L = 600Ω			-114		dB
		f = 20Hz to 20kHz, $V_{COM_}$ = 0.5V_{Pk-Pk}, DC bias = 0V, R_L = 32Ω			-110		

Electrical Characteristics (continued)

(V_{CC} = 2.5V to 5.5V, T_A = -40°C to +85°C unless otherwise noted. Typical values are at V_{CC} = +2.5V, T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
THERMAL PROTECTION						
Thermal Shutdown	T_{SHDN}			150		°C
Thermal Hysteresis	T_{HYST}			20		°C
ESD PROTECTION						
HBM		All pins		±2		kV

Note 1: All devices are 100% production tested at T_A = +25°C. All temperature limits are guaranteed by design.
Note 2: On-resistance match between channels is defined as $\Delta R_{ON_MAX} = |R_{ON_CH1} - R_{ON_CH2}|$
Note 3: On-resistance flatness is defined as the difference between the maximum and minimum values of on-resistance, as measured over the specified analog signal ranges.

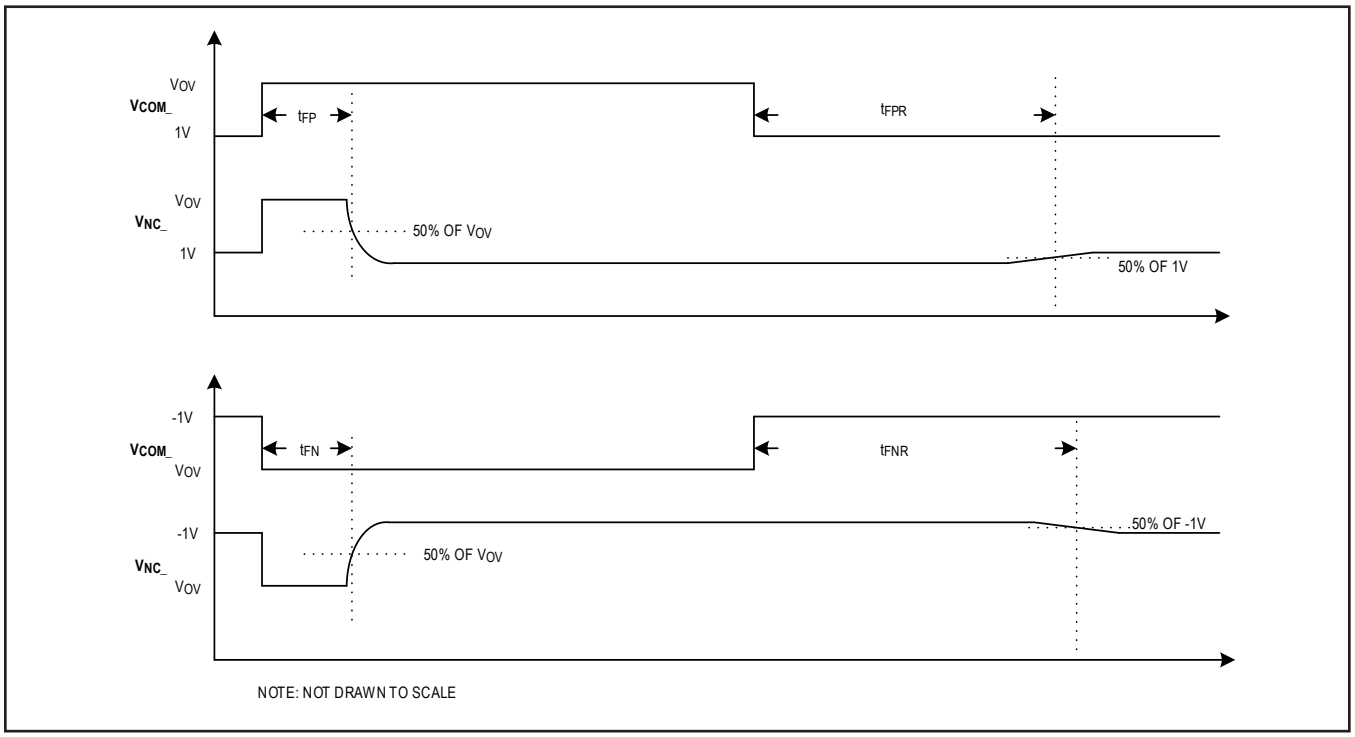
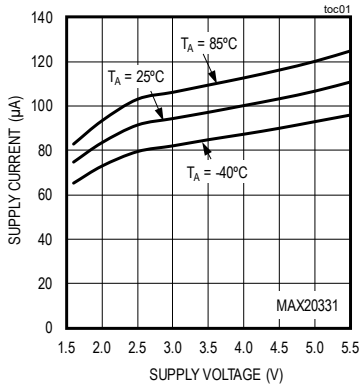


Figure 1. Timing Diagram

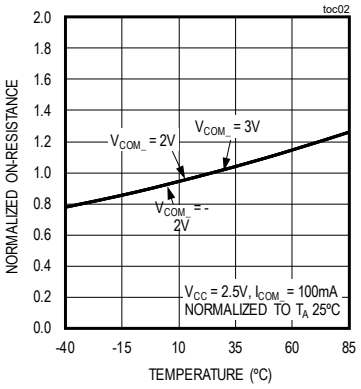
Typical Operating Characteristics (continued)

(V_{CC} = +3.7V, T_A = +25°C, unless otherwise noted.)

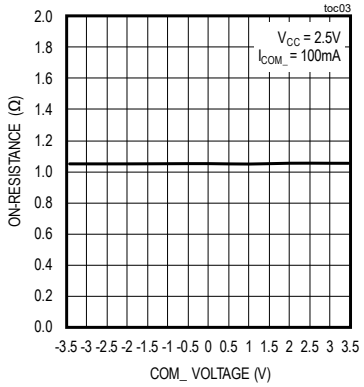
SUPPLY CURRENT vs. SUPPLY VOLTAGE



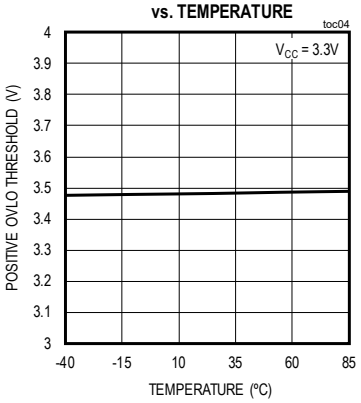
NORMALIZED ON-RESISTANCE vs. TEMPERATURE



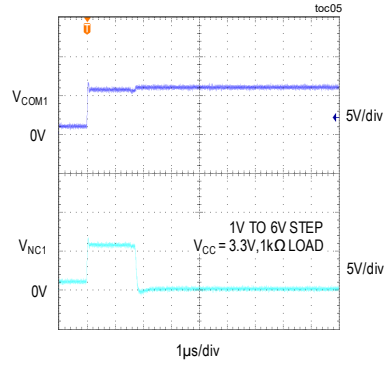
ON-RESISTANCE vs. COM_ VOLTAGE



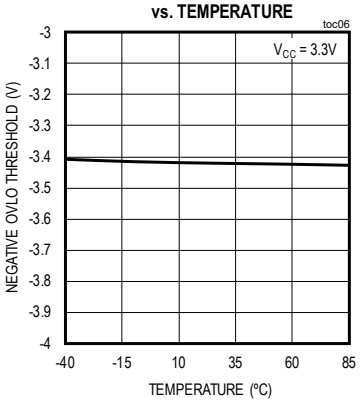
POSITIVE OVLO THRESHOLD vs. TEMPERATURE



POSITIVE OVLO RESPONSE TIME



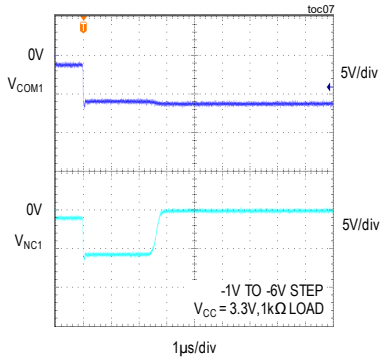
NEGATIVE OVLO THRESHOLD vs. TEMPERATURE



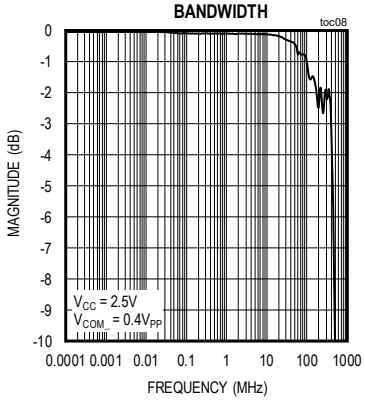
Typical Operating Characteristics (continued)

(V_{CC} = +3.7V, T_A = +25°C, unless otherwise noted.)

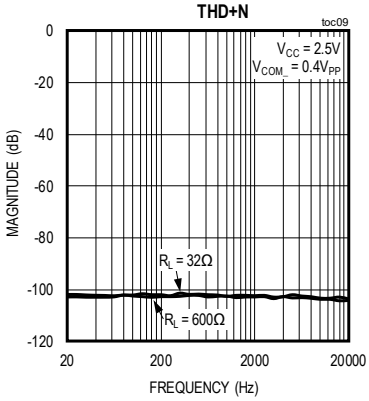
NEGATIVE OVLO RESPONSE TIME



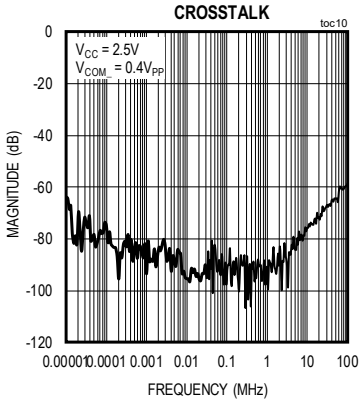
BANDWIDTH



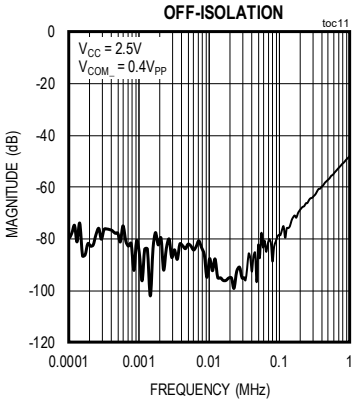
THD+N



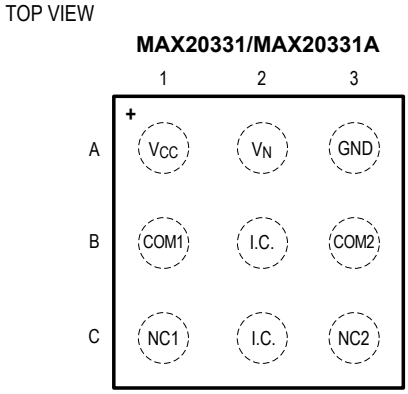
CROSSTALK



OFF-ISOLATION



Bump Configurations

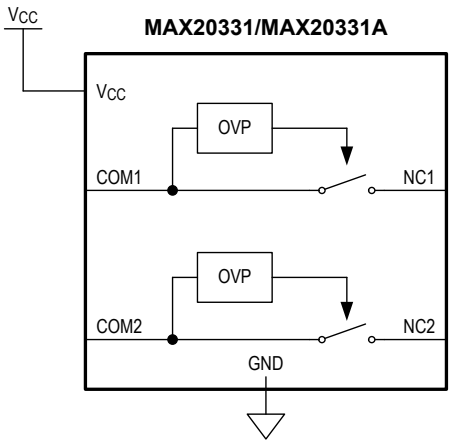


WLP
(1.23mm x 1.23mm)

Bump Description

BUMP	NAME	FUNCTION
A1	V_{CC}	Supply Voltage Input. Bypass V_{CC} to ground with a 0.1µF decoupling capacitor as close as possible to the device
A2	V_N	1nF Capacitor Connection. Connect a 1nF capacitor to ground as close as possible to the device.
A3	GND	Ground
B1	COM1	External Audio Line 1. Connect to external audio source.
B2	I.C.	Internally Connected. Connect to GND.
B3	COM2	External Audio Line 2. Connect to external audio source.
C1	NC1	Protected Audio Line 1. Connect to audio codec.
C2	I.C.	Internally Connected. Connect to GND.
C3	NC2	Protected Audio Line 2. Connect to audio codec.

Functional Diagram



Detailed Description

The MAX20331/MAX20331A OVP devices offer positive and negative over voltage protection for electronics in the audio signal path connected to a 3.5mm audio jack. Both devices offer protection up to ±40V, well past the over voltage threshold.

When the COM_ voltage reaches the OVP threshold, the COM_ to NC_ path is opened to disconnect sensitive electronics from the over voltage condition. The MAX20331 threshold is ±3.45V while the MAX20331A threshold is ±5.5V. These thresholds are maintained across the full range of supply voltages.

Applications Information

For additional ESD and high-voltage protection, place external ESD protection devices on the COM1 and COM2 lines. These external devices should be bidirectional and no trigger on higher than ±20V.

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX20331EWL+	-40°C to +85°C	9 WLP
MAX20331EWL+T	-40°C to +85°C	9 WLP
MAX20331AEWL+	-40°C to +85°C	9 WLP
MAX20331AEWL+T	-40°C to +85°C	9 WLP

+Denotes a lead(Pb)-free/RoHS-compliant package.

T Denotes tape-and-reel

Chip Information

PROCESS: BiCMOS

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	6/18	Initial release	—

For pricing, delivery, and ordering information, please visit Maxim Integrated's online storefront at **https://www.maximintegrated.com/en/storefront/storefront.html**.

Maxim Integrated cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim Integrated product. No circuit patent licenses are implied. Maxim Integrated reserves the right to change the circuitry and specifications without notice at any time. The parametric values (min and max limits) shown in the Electrical Characteristics table are guaranteed. Other parametric values quoted in this data sheet are provided for guidance.

Maxim Integrated and the Maxim Integrated logo are trademarks of Maxim Integrated Products, Inc. © 2018 Maxim Integrated Products, Inc.

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for Power Management Specialised - PMIC ***category:***

Click to view products by Maxim ***manufacturer:***

Other Similar products are found below :

LV5686PVC-XH FAN7710VN NCP391FCALT2G SLG7NT4081VTR SLG7NT4192VTR AP4313UKTR-G1 AS3729B-BWLM MB39C831QN-G-EFE2 LV56841PVD-XH AP4306BUKTR-G1 MIC5164YMM PT8A3252WE NCP392CSFCCT1G PT8A3284WE PI3VST01ZEEX PI5USB1458AZAEX PI5USB1468AZAEX MCP16502TAC-E/S8B MCP16502TAE-E/S8B MCP16502TAA-E/S8B MCP16502TAB-E/S8B TCKE712BNL,RF ISL91211AIKZT7AR5874 ISL91211BIKZT7AR5878 MCP16501TC-E/RMB ISL91212AIIZ-TR5770 ISL91212BIIZ-TR5775 CPX200D AX-3005D-3 TP-1303 TP-1305 TP-1603 TP-2305 TP-30102 TP-4503N MIC5167YML-TR LPTM21-1AFTG237C LR745N8-G MPS-3003L-3 MPS-3005D SPD-3606 STLUX383A TP-60052 ADN8834ACBZ-R7 LM26480SQ-AA/NOPB LM81BIMTX-3/NOPB LM81CIMT-3/NOPB MIC5166YML-TR GPE-4323 GPS-2303