DS2711, DS2712

Loose Cell NiMH Chargers

NiMH Battery Charger Detects and Avoids Charging Alkaline Cells

Description

The DS2711 and DS2712 are ideal for in-system or stand-alone charging of 1 or 2 AA or AAA NiMH "loose" cells. Temperature, voltage, and charge time are monitored to provide proper fast charging control algorithms for nickel metal hydride (NiMH) batteries. Battery tests are included to detect defective or inappropriate cells such as alkaline primary batteries. The DS2711/DS2712 support series and parallel topologies, with independent monitoring and control of each cell. Charging of NiCd chemistry cells is also supported.

Awards

DS2711: EDAW-NEC Power-Supply Product Award Winner 2005

DS2711 Loose Cell NiMH Linear Charger: EDN Innovation Award, Finalist 2004

Key Features

Applications / Uses

- Charge 1 or 2 NiMH Cells
- Detect and Avoid Charging Alkaline Cells
- Precharge Deeply Depleted Cells
- Fast Charge NiMH with -ΔV Termination Sensitivity of 2mV (typ)
- Monitor Voltage, Temperature, and Time for Safety and Secondary Termination
- Regulate Charge Current:
  - Linear Control (DS2711)
  - Switch-Mode Control (DS2712)
- Drive PMOS or PNP-Type Pass Element or Switch, or an Optocoupler
- Compatible with Popular Optocouplers and Integrated Primary Side PWM Controllers
- Small 16-Pin SO or TSSOP Package

Desktop/Stand-Alone Chargers (AAA/AA)
Digital Still Cameras
Gaming
Music Players
Toys

Key Specifications: Battery Chargers

Part Number	Cell Chemistry	Number of NiMH or NiCd cells	Protected V_{IN} (max) (V)	Charging V_{IN} (max) (V)	Charge Rate Set by	Charge Termination	Charge Regulation	Features	EV-Kit	Package	Operating Temp. Range (°C)	
DS2711	NiCd NiMH	1 2	5.5	5.5	Resistor	-ΔV	Linear	• Stand Alone • Thermistor Input • Timer	Yes	SOIC/16 TSSOP/16	-20 to +70	
DS2712							Switchmode					

See All Battery Chargers (62)

Notes:
**This pricing is BUDGETARY, for comparing similar parts. Prices are in U.S. dollars and subject to change. Quantity pricing may vary substantially and international prices may differ due to local duties, taxes, fees, and exchange rates. For volume-specific prices and delivery, please see the price and availability page or contact an authorized distributor.

Application Notes

Application Note 3388: Detecting Primary Cells with the DS2711/12 - DS2711, DS2712
Application Note 3607: Charging Batteries from USB - DS2711, DS2712
Application Note 3999: Overview of Rechargeable Batteries and Fast Stand-Alone Chargers - DS2711, DS2712
Application Note 4215: Estimating Switching Speed for the DS2712 NiMH Battery Charger - DS2712

Evaluation Kits

DS2711K, DS2712K

Design Guides

Battery Management (PDF)
Power Management for Battery-Powered Equipment (PDF)

Reliability Reports

Reliability Report: DS2711.pdf DS2712.pdf

Software / Models

none

Ordering Information

Notes:

1. Other options and links for purchasing parts are listed at:
2. Didn't Find What You Need? Ask our applications engineers. Expert assistance in finding parts, usually within one business day.
3. Part number suffixes: T or T&R = tape and reel; + = RoHS/lead-free; # = RoHS/lead-exempt. More: SeeFull Data Sheet or Part Naming Conventions.
4. * Some packages have variations, listed on the drawing. "PkgCode/Variation" tells which variation the product uses. Note that "+", "#", "-" in the part number suffix describes RoHS status. Package drawings may show a different suffix character.

Devices: 1-8 of 8

DS2711	Free Sample	Buy	Package: TYPE PINS FOOTPRINT DRAWING CODE/VAR *	Temp	RoHS/Lead-Free? Materials Analysis
DS2711Z+T&R			SOIC;16 pin; Dwg: 21-0041 (PDF) Use pkgcode/variation: S16+1*	-40°C to +85°C	RoHS/Lead-Free: Lead Free Materials Analysis
DS2711Z+			SOIC;16 pin; Dwg: 21-0041 (PDF) Use pkgcode/variation: S16+1*	-40°C to +85°C	RoHS/Lead-Free: Lead Free Materials Analysis
DS2711E+			TSSOP;16 pin; Dwg: 21-0066 (PDF) Use pkgcode/variation: U16+1*	-40°C to +85°C	RoHS/Lead-Free: Lead Free Materials Analysis
DS2711E+T&R			TSSOP;16 pin; Dwg: 21-0066 (PDF) Use pkgcode/variation: U16+1*	-40°C to +85°C	RoHS/Lead-Free: Lead Free Materials Analysis
DS2712	**Free Sample**	**Buy**	**Package: TYPE PINS FOOTPRINT DRAWING CODE/VAR ***	**Temp**	**RoHS/Lead-Free? Materials Analysis**

DS2712Z+			SOIC;16 pin; Dwg: 21-0041 (PDF) Use pkgcode/variation: S16+1*	-40°C to +85°C	RoHS/Lead-Free: Lead Free Materials Analysis
DS2712Z+T&R			SOIC;16 pin; Dwg: 21-0041 (PDF) Use pkgcode/variation: S16+1*	-40°C to +85°C	RoHS/Lead-Free: Lead Free Materials Analysis
DS2712E+			TSSOP;16 pin; Dwg: 21-0066 (PDF) Use pkgcode/variation: U16+1*	-40°C to +85°C	RoHS/Lead-Free: Lead Free Materials Analysis
DS2712E+T&R			TSSOP;16 pin; Dwg: 21-0066 (PDF) Use pkgcode/variation: U16+1*	-40°C to +85°C	RoHS/Lead-Free: Lead Free Materials Analysis

More Information

New Product Press Release 2004-10-23

DS2711/DS2712
Loose Cell NiMH Chargers

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FEATURES
- Charge 1 or 2 NiMH Cells
- Detect and Avoid Charging Alkaline Cells
- Precharge Deeply Depleted Cells
- Fast Charge NiMH with -ΔV Termination Sensitivity of 2mV (typ)
- Monitor Voltage, Temperature, and Time for Safety and Secondary Termination
- Regulate Charge Current:
  - Linear Control (DS2711)
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- Drive PMOS or PNP-Type Pass Element or Switch, or an Optocoupler
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APPLICATIONS
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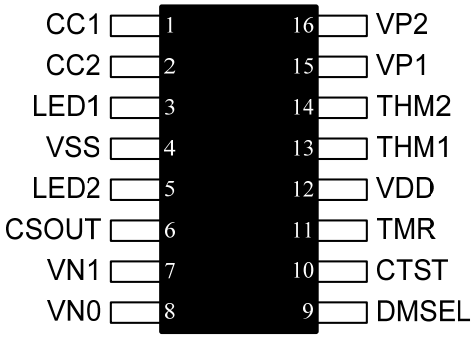
Music Players
Games
Toys

PIN CONFIGURATION



16 SO (150 mil) / TSSOP (4.4 mm)
See Table 1 for Ordering Information.

PIN DESCRIPTION

PIN	NAME	FUNCTION
1	CC1	Cell 1 Charge-Control Output
2	CC2	Cell 2 Charge-Control Output
3	LED1	Cell 1 Status
4	V_{SS}	Ground Reference and Chip-Supply Return
5	LED2	Cell 2 Status, Mode-Select Input
6	CSOUT	Current-Sense Output
7	VN1	Current-Sense + Input
8	VN0	Current-Sense - Input
9	DMSEL	Display-Mode Select
10	CTST	Cell Test Threshold Set
11	TMR	Charge Timer Set
12	V_{DD}	Chip-Supply Input (4.0V to 5.5V)
13	THM1	Cell 1 Thermistor Input
14	THM2	Cell 2 Thermistor Input
15	VP1	Cell 1 Positive-Terminal Sense Input
16	VP2	Cell 2 Positive-Terminal Sense Input

Table 1. ORDERING INFORMATION

PART	MARKING	PIN-PACKAGE
DS2711Z	DS2711	16 SO
DS2711Z/T&R	DS2711	16 SO, Tape-and-Reel
DS2712Z	DS2712	16 SO
DS2712Z/T&R	DS2712	16 SO, Tape-and-Reel
DS2711Z+	DS2711	16 SO
DS2711Z+T&R	DS2711	16 SO, Tape-and-Reel
DS2712Z+	DS2712	16 SO
DS2712Z+T&R	DS2712	16 SO, Tape-and-Reel
DS2711E+	DS2711	16 TSSOP
DS2711E+T&R	DS2711	16 TSSOP, Tape-and-Reel
DS2712E+	DS2712	16 TSSOP
DS2712E+T&R	DS2712	16 TSSOP, Tape-and-Reel

+ Denotes lead-free package.

ABSOLUTE MAXIMUM RATINGS*

Voltage on All Pins Relative to V_{SS}	-0.3V to +6V
Voltage on DMSEL	V_{DD} + 0.3V
Continuous Sink Current CC1, CC2, LED1, LED2 and CSOUT	20mA
Operating Temperature Range	-40°C to +85°C
Storage Temperature Range	-55°C to +125°C
Soldering Temperature	See IPC/JEDECJ-STD-020

**This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.*

RECOMMENDED DC OPERATING CONDITIONS

($4.0V \le V_{DD} \le 5.5V$; T_A = -20°C to +70°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V_{DD}	(Note 1)	4.0		5.5	V
Input Voltage Range		LED2, DMSEL	-0.3		+5.5	V

DC ELECTRICAL CHARACTERISTICS

($4.0V \le V_{DD} \le 5.5V$, T_A = -20°C to +70°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Current, V_{DD}	I_{DD}	Operating mode		250	500	µA
UVLO Threshold	V_{UVLO}	V_{DD} rising (Note 1)		3.5	3.9	V
UVLO Hysteresis	V_{UHYS}	V_{DD} falling from above V_{UVLO}	40			mV
Output-Voltage Low, CC1, CC2, LED1, LED2	V_{OL1}	V_{DD} = 5.0V, I_{OL} = 20mA (Note 1)			1.0	V
Output-Voltage Low, CSOUT	V_{OL2}	V_{DD} = 5.0V, I_{OL} = 20mA (Note 1)		0.75	1.25	V
Leakage Current, CC1, CC2, LED1, LED2, CSOUT	I_{LKG}	V_{DD} = 5.0V, Output inactive	-1		+1	µA
Threshold Voltage, -ΔV Termination	$V_{-\Delta V}$	After t_{THO}	1.0	2.0	3.0	mV
Mode Test Current, DMSEL, LED2	I_{MTST}	(Notes 2, 3)		5	15	µA

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Logic-High, DMSEL, LED2	V_{IH}	(Note 1)	V_{DD} - 0.2V			V
Input Logic-Low, DMSEL, LED2	V_{IL}	(Note 1)			0.2	V
Input Leakage Current, DMSEL	I_{IL1}	After power-up mode select, DMSEL = V_{DD} or V_{SS}	-1		+1	µA
Threshold Voltage, Cell Test	V_{CTST}	R_{CTST} = 80kΩ	85	100	115	mV
Threshold Voltage, Cell Voltage Low	$V_{BAT-LOW}$	CC1 = CC2 = high-Z (Note 4)	0.9	1.0	1.1	V
Threshold Voltage, Cell Voltage Max1	$V_{BAT-MAX1}$	CC1 = CC2 = high-Z (Note 4)	1.55	1.65	1.75	V
Threshold Voltage, Cell Voltage Max2	$V_{BAT-MAX2}$	CC1, CC2 active (Note 4)	1.64	1.75	1.86	V
Threshold Voltage Delta	$V_{BAT-MAXΔ}$	$V_{BAT-MAX2}$ - $V_{BAT-MAX1}$ (Note 5)	90	100	110	mV
Threshold Voltage, Thermistor - Min	$V_{THM-MIN}$	(Notes 1, 4, 6)		V_{DD} x 0.73		V
Threshold Voltage, Thermistor - Max	$V_{THM-MAX}$	(Notes 1, 4, 6)	0.30	V_{DD} x 0.33	0.36	V
Threshold Voltage, Thermistor - Stop	$V_{THM-STOP}$	(Notes 1, 4, 6)		V_{DD} x 0.29		V
Threshold Current, TMR Pin Suspend	$I_{TMR-SUS}$			0.1	0.5	µA
Presence Test Current, VP1, VP2	I_{PTST}	Parallel: V_{DD} ≥ 4.0V, Series: V_{DD} ≥ 4.5V		10	15	µA
Reverse Leakage Current, VP1, VP2	I_{LKGR}	V_{DD} = 0V, VP1 = 1.5V, VP2 = 3.0V			2	µA
Current-Sense Reference Voltage	V_{IREF}	(Note 1, 4, 7)		125		mV
			-6%		+6%	%
Gain, Current-Sense Error Amp	G_M	DS2711 (Note 8)	0.9		1.5	Ω^{-1}
Gain, Current-Sense Comparator	G_M	DS2712 (Note 8)	10			Ω^{-1}
Propagation Time, Current-Sense Comparator	t_{PDLY}	DS2712, 2mV over/underdrive			0.25	µs
Hysteresis, Current-Sense Comparator	$V_{HYS-COMP}$	DS2712	22	24	26	mV

ELECTRICAL CHARACTERISTICS: TIMING

(4.0V ≤ V_{DD} ≤ 5.5V, T_A = -20°C to +70°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Internal Timebase Period	t_{BASE}			0.96		s
Internal Timebase Accuracy			-10		+10	%
Duty Factor, Series Fast Charge		CC1		0.969		
Duty Factor, Series Precharge/Top-Off		CC1		0.250		
Duty Factor, Parallel Fast Charge		CC1, CC2		0.484		

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Duty Factor, Parallel Precharge/Top-Off		CC1, CC2		0.125		
Duty Factor, Maintenance Charge		CC1, CC2		0.0156		
Cell Test Interval	t_{CTST}			31		s
Precharge Time-Out	t_{PCHG}	$V_{CELL} < V_{BAT-MIN}$		34		minutes
Fast-Charge Termination Hold-Off Period	t_{THO}			4		minutes
Fast-Charge Flat Voltage Time-Out	t_{FLAT}	V_{CELL} not increasing		16		minutes
Charge Timer Period	t_{CTMR}	R_{TMR} = 100kΩ		2.5		h
Charge Timer Accuracy		R_{TMR} = 100kΩ	-5		+5	%
Charge Timer Range	$t_{CTMR-RANGE}$		0.5		10	h

Note 1: Voltages relative to V_{SS}.
Note 2: I_{MTST} current is applied as a source current and as a sink current within 5ms after power-up.
Note 3: When operating in two-cell-series charge configuration, the DMSEL pin must have less than 50pF of external load capacitance for proper operation. If the load capacitance is greater than 50pF, a resistor voltage divider should be used to maintain DMSEL at V_{DD} / 2.
Note 4: Specification applicable during charge cycle with T_A = 0°C to +70°C.
Note 5: $V_{BAT-MAX1}$ and $V_{BAT-MAX1}$ are generated from the same reference. Their ranges never overlap.
Note 6: $V_{THM-MIN}$, $V_{THM-MAX}$, and $V_{THM-STOP}$ are fixed ratios of V_{DD}. Their ranges never overlap.
Note 7: Tested with I_{CSOUT} = -1mA.
Note 8: Gain tested with 1mV step with I_{CSOUT} = -1mA.

Table 4. PARALLEL CONFIGURATION, EACH CELL

MODE	CURRENT LIMIT 500mA			CURRENT LIMIT 1000mA		
Cell Capacity	900mAH	1700mAH	2200mAH	900mAH	1700mAH	2200mAH
Fast	C/3.72	C/7.02	C/9.08	C/1.86	C/3.51	C/4.54
Precharge/Top-Off	C/14.4	C/27.2	C/35.2	C/7.20	C/13.6	C/17.6
Maintenance	C/115	C/218	C/282	C/57.6	C/109	C/141

Series and Single Cell Charging Example:

In the series and single-cell modes, the effective fast charge current is equal to 0.969 times the regulated current limit and the top-off current is 0.25 times the regulated current. The maintenance mode is identical to the parallel charging rate, that is, 1/64 times the regulated current. The C-rates for charging 3 different cell capacities using a 500mA and a 1000mA current source are shown in the following table.

Table 5. SERIES CONFIGURATION, EACH CELL

MODE	CURRENT LIMIT 500mA			CURRENT LIMIT 1000mA		
Cell Capacity	900mAH	1700mAH	2200mAH	900mAH	1700mAH	2200mAH
Fast	C/1.86	C/3.51	C/4.54	C/0.93	C/1.75	C/2.27
Precharge/Top-Off	C/7.20	C/13.6	C/17.6	C/3.60	C/6.80	C/8.80
Maintenance	C/115	C/218	C/282	C/57.6	C/109	C/141

LED1 and LED2 Outputs, MODE-Select Input

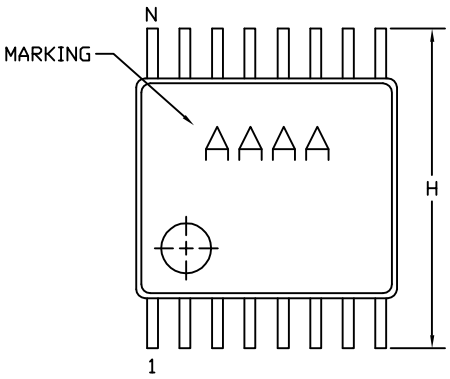
Open-drain outputs LED1 and LED2 pull low to indicate charge status. When inactive, the outputs are high impedance. LED1 displays the status for the cell monitored by VP1 and LED2 displays the status for the cell monitored by VP2.

The LED pins drive low in three “blink” patterns to annunciate the charge status. Table 6 summarizes the LED operation in each display mode (DM0, DM1, DM2) for each charge condition. In parallel mode, LED1 indicates the status of the cell whose positive terminal is connected to VP1 and LED2 indicates the status of the cell whose positive terminal is connected to VP2. In series mode, LED1 indicates the charge status for both cells since they are charged in series.

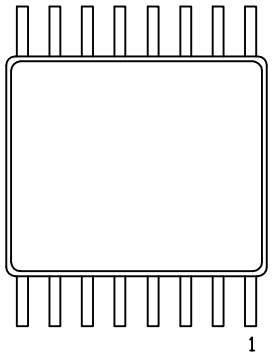
Table 6. DISPLAY PATTERNS BY DISPLAY MODE AND CHARGE ACTIVITY

DISPLAY MODE		CHARGE ACTIVITY			
	DMSEL PIN	NO BATTERY	PRE/FAST/TOP-OFF CHARGING	MAINTENANCE	FAULT
DM0	Low	High-Z	Low	0.80s Low 0.16s High-Z	0.48s Low 0.48s High-Z
DM1	Float	High-Z	Low	High-Z	0.16s Low 0.16s High-Z
DM2	High	High-Z	0.80s Low 0.16s High-Z	Low	0.16s Low 0.16s High-Z

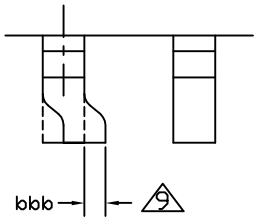
High-Z = High Impedance



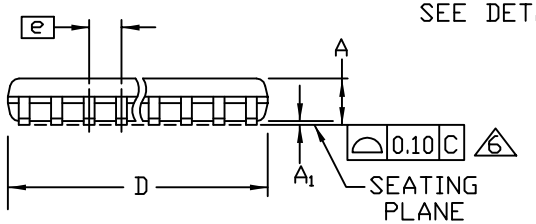
TOP VIEW



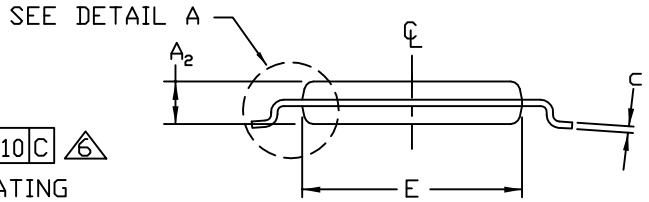
BOTTOM VIEW



BENT LEAD DETAIL

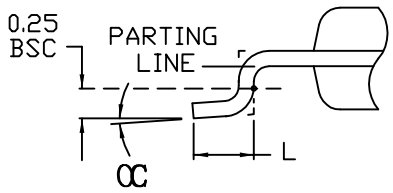


SIDE VIEW

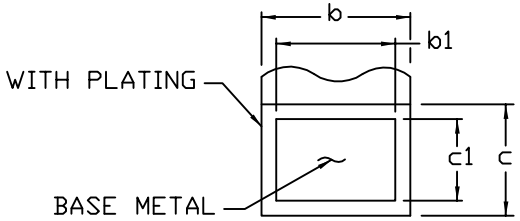


END VIEW

SYMBOL	COMMON DIMENSIONS			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	——	1.10		.043
A_1	0.05	0.15	.002	.006
A_2	0.85	0.95	.033	.037
b	0.19	0.30	.007	.012
b_1	0.19	0.25	.007	.010
c	0.09	0.20	.004	.008
c_1	0.09	0.14	.004	.006
D	SEE VARIATIONS		SEE VARIATIONS	
E	4.30	4.50	.169	.177
e	0.65 BSC		.026 BSC	
H	6.25	6.55	.246	.258
L	0.50	0.70	.020	.028
N	SEE VARIATIONS		SEE VARIATIONS	
α	0°	8°	0°	8°
bbb	0.10 MAX			



DETAIL A



LEAD TIP DETAIL

JEDEC MO-153	N		PKG. CODES	VARIATIONS			
				MILLIMETERS		INCHES	
				MIN.	MAX.	MIN.	MAX.
AB-1	14	D	U14-1; U14-2	4.90	5.10	.193	.201
AB	16	D	U16-1; U16-2	4.90	5.10	.193	.201
AC	20	D	U20-2; U20M-2 U20-3	6.40	6.60	.252	.260
AD	24	D	U24-1	7.70	7.90	.303	.311
AE	28	D	U28-1; U28-2; U28-3	9.60	9.80	.378	.386

NOTES

1. DIMENSIONS D AND E DO NOT INCLUDE FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm PER SIDE
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC OUTLINE MO-153. SEE JEDEC VARIATIONS TABLE
5. "N" REFERS TO NUMBER OF LEADS
6. LEAD COPLANARITY 0.10 MM MAX.
7. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY
8. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY
9. BENT LEAD 0.10 MM MAX.
10. ALL DIMENSIONS APPLY TO BOTH LEADED (-) AND PBFREE (+) PKG. CODES.

—DRAWING NOT TO SCALE—

MAXIM

TITLE:
PACKAGE OUTLINE,
TSSOP 4.40mm BODY

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0066	J	1/1