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March 2013

FSA859 — Dual-Voltage, 0.8Ω SPDT Analog Switch with Power-Off Isolation

Features

- Power-Off Isolation (V_{CC}=0V)
- 0.8Ω Maximum On Resistance (R_{ON}) for 4.5V V_{CC}
- 0.25Ω Maximum R_{ON} Flatness for 4.5V V_{CC}
- Broad V_{CC} Operating Range: 1.65V to 5.5V
- Fast Turn-On and Turn-Off Times
- Control Input Referenced to V_{IO}
- Break-Before-Make Enable Circuitry
- 0.5mm WLCSP packaging
- ESD Performance
  - HBM: JESD22-A114, I/O to GND 8kV
  - CDM: JESD22-C101 500V
  - IEC61000-4-2 Contact / Air 8kV / 15kV

Applications

- Cellular Phone
- Portable Media Player
- PDA

Description

The FSA859 is a high-performance Single-Pole / Double-Throw (SPDT) analog switch for audio applications driven by low voltage (1.8V) baseband processors or ASICs. The device features ultra-low R_{ON} of 0.8Ω (maximum) at 4.5V V_{CC} and operates over the wide V_{CC} range of 1.65V to 5.5V. The device is fabricated with sub-micron CMOS technology to achieve fast switching speeds and is designed for break-before-make operation.

The FSA859 interfaces between the low-voltage ASIC and regular audio amplifiers and CODECs operating up to the supply range of 5.5V through the dual-voltage supplies of V_{IO} and V_{CC}. The V_{IO} supply operates the control circuitry, allowing for 1.8V (typical) signals on the control pin (Sel).

IMPORTANT NOTE:

For additional performance information, please contact analogswitch@fairchildsemi.com.

Ordering Information

Part Number	Operating Temperature Range	Top Mark	Eco Status	Package	Packing Method
FSA859UCX	-40°C to +85°C	N2	Green	8-Ball WLCSP, 0.5mm pitch	Tape and Reel

For Fairchild's definition of "green" Eco Status, please visit: http://www.fairchildsemi.com/company/green/rohs_green.html.

Analog Symbols

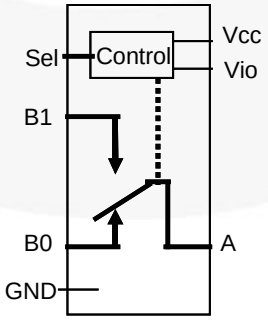

Figure 1. Analog Symbol

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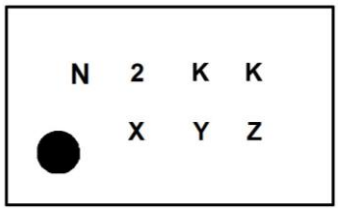
Marking Information



KK = Lot Run Code
X = Year
Y = Work Week
Z = Assembly Site

Figure 2. Top Mark with Pin 1 Orientation

Pin Configuration

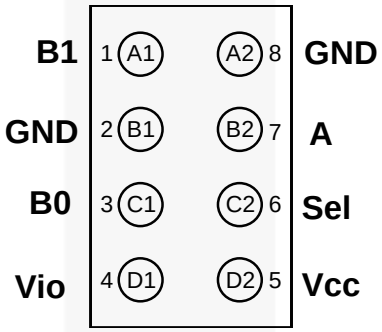


Figure 3. Pin Assignments (Top Through View)

Pin Definitions

Pin	Ball	Name	Description
1	A1	B1	Data Port (Normally Open)
2	B1	GND	Ground
3	C1	B0	Data Ports (Normally Closed)
4	D1	V_{IO}	Digital Control Supply
5	D2	V_{CC}	Supply Voltage
6	C2	Sel	Control Input
7	B2	A	Common Data Port
8	A2	GND	Ground

Truth Table

Control Input (Sel)	Function
LOW	B0 connected to A
HIGH	B1 connected to A

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Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter		Min.	Max.	Unit
V_{CC}	Supply Voltage		-0.5	6.5	V
V_{IO}	Digital Control Supply Voltage		-0.5	6.5	V
V_{sw}	Switch Voltage[1]		-0.5	V_{CC} + 0.5	V
V_{IN}	Input Voltage[1]		-0.5	6.5	V
I_{IK}	Input Diode Current			-50	mA
I_{SW}	Switch Current (Continuous)			200	mA
I_{SWPEAK}	Peak Switch Current	Pulsed at 1ms Duration, <10% Duty Cycle		400	mA
P_D	Power Dissipation at 85°C			180	mW
T_{STG}	Storage Temperature Range		-65	+150	°C
T_J	Maximum Junction Temperature			+150	°C
T_L	Lead Temperature (Soldering, 10 seconds)			+260	°C
ESD	Human Body Model (JEDEC: JESD22-A114)	I/O to GND: A		8	kV
		All Pins		2	
	Charged Device Model (JEDEC: JESD22-C101)			500	V
	Machine Model (JEDEC: JESD22-A115)			100	V
	IEC6100-4-2 Discharge system test performed on Fairchild's FSA859 applications testing board	Contact		8	kV
		Air		15	

Note:

1. The input and output negative ratings may be exceeded if the input and output diode current ratings are observed.

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	Supply Voltage	1.65	5.50	V
V_{IO}	Digital Control Supply	1.65	1.95	V
Sel	Control Input Voltage[2]	0	V_{IO}	V
V_{SW}	Switch Input Voltage	0	V_{CC}	V
T_A	Operating Temperature	-40	+85	°C
θ_{JA}	Thermal Resistance, Still Air		350	°C/W

Note:

2. Control Input must be held HIGH or LOW; it must not float.

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Electrical Characteristics

All typical values are at 25°C unless otherwise specified. V_{IO}=1.65 to 1.95V.

Symbol	Parameter	V_{CC} (V)	Conditions	T_A=+25°C			T_A=-40 to +85°C		Unit
				Min.	Typ.	Max.	Min.	Max.	
V_{IHIO}	Input Voltage High - V_{IO}	1.95 to 5.50					0.65•V_{IO}	V_{IO}	V
V_{ILIO}	Input Voltage Low - V_{IO}	1.95 to 5.50					0	0.35•V_{IO}	V
I_{IN}	Control Input Leakage	1.95 to 5.50	V_{Sel}=0 or V_{IO}	-2		2	-20	20	nA
$I_{NO(0FF)}$, $I_{NC(OFF)}$,	Off-Leakage Current of Port B0 and B1 (6)	5.50	A=1V,4.5V B0 or B1=4.5, 1V	-10		10	-50	50	nA
		3.60	A=1V,3.0V B0 or B1=3.0, 1V	-10		10	-50	50	
		2.70	A=0.5V,2.3V B0 or B1=2.3, 0.5V	-10		10	-50	50	
		1.95	A=0.3V,1.65V B0 or B1=1.65 ,0.3 V	-5		5	-20	20	
$I_{NO(On)}$, $I_{NC(On)}$	On-Leakage Current of Port B0 and B1 (6)	5.50	A=float B0 or B1=4.5, 1V	-20		20	-100	100	nA
		3.60	A=float B0 or B1=3.0, 1V	-10		10	-20	20	
		2.70	A=float B0 or B1=2.3, 0.5V	-10		10	-20	20	
		1.95	A=float B0 or B1=1.65, 0.3V	-5		5	-20	20	
$I_{A(ON)}$	On Leakage Current of Port A (6)	5.50	A=1V,4.5V; B0 or B1=1V, 4.5V or floating	-20		20	-100	100	nA
		3.60	A=1V, 3.0VB0 or B1=1V, 3.0V or floating	-10		10	-20	20	
		2.70	A=0.5V, 2.3V, B0 or B1=0.5V, 2.3V, or floating	-10		10	-20	20	
		1.95	A=0.3V, 1.65V; B0 or B1=0.3V, 1.65V, or floating	-5		5	-20	20	
I_{OFF}	Power Off Leakage Current of Port A & Port B(6)	0	A=0 to 5.5V B0 or B1=0 to 5.5V	-1.00	0.01	1.00	-5.00	5.00	µA
I_{CC}	Quiescent Supply Current	5.50	V_{IN}=0 or V_{CC}, I_{OUT}=0		10	50		500	nA
		3.60	V_{IN}=0 or V_{CC}, I_{OUT}=0		1.0	25.0		100.0	
		2.70	V_{IN}=0 or V_{CC}, I_{OUT}=0		0.5	20.0		50.0	
		1.95	V_{IN}=0 or V_{CC}, I_{OUT}=0		0.5	15.0		50.0	

Continued on the following page…

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Electrical Characteristics (Continued)

All typical values are at 25°C unless otherwise specified. V_{IO}=1.65 to 1.95V.

Symbol	Parameter	V_{CC} (V)	Conditions	T_A=+25°C			T_A=-40 to +85°C		Unit
				Min.	Typ.	Max.	Min.	Max.	
R_{ON}	Switch On Resistance(3,6)	4.50	I_{OUT}=-100mA, B0 or B1=2.5V		0.50	0.75		0.80	Ω
		3.00	I_{OUT}=-100mA, B0 or B1=2.0V		0.75	0.90		1.2	
		2.25	I_{OUT}=-100mA, B0 or B1=1.8V		1.0	1.3		1.6	
		1.65	I_{OUT}=-100mA, B0 or B1=1.2V		2.5	5.0		7.0	
ΔR_{ON}	On Resistance Matching Between Channels(4,6)	4.50	I_{OUT}=-100mA, B0 or B1=2.5V		0.05	0.10		0.10	Ω
		3.00	I_{OUT}=-100mA, B0 or B1=2.0V		0.10	0.15		0.15	
		2.25	I_{OUT}=-100mA, B0 or B1=1.8V		0.15	0.20		0.20	
		1.65	I_{OUT}=-100mA, B0 or B1=1.2V		0.15	0.40		0.40	
$R_{FLAT(ON)}$	On Resistance Flatness(5,6)	4.50	I_{OUT}=-100mA, B0 or B1=1.0V, 1.5V, 2.5V		0.075	0.250		0.250	Ω
		3.00	I_{OUT}=-100mA, B0 or B1=0.8V, 2.0V		0.1	0.3		0.3	
		2.25	I_{OUT}=-100mA, B0 or B1=0.8V, 1.8V		0.25	0.50		0.6	
		1.65	I_{OUT}=-100mA, B0 or B1=0.6V, 1.2V		3.5				

Notes:

3. On resistance is determined by the voltage drop between A and B pins at the indicated current through the switch.
4. $\Delta R_{ON}=R_{ON}$ maximum – R_{ON} minimum measured at identical V_{CC}, temperature, and voltage.
5. Flatness is defined as the difference between the maximum and minimum value of on resistance over the specified range of conditions.
6. Guaranteed by characterization, not production tested for V_{CC}=1.65 – 1.95V.

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AC Electrical Characteristics

All typical value are at V_{IO}=1.8V and V_{CC}=1.8V, 2.5V, 3.0V, and 5.0V at 25°C unless otherwise specified.

Symbol	Parameter	V_{CC} (V)	Conditions	T_A=+25ºC			T_A=-40 to +85ºC		Unit	Figure
				Min.	Typ.	Max.	Min.	Max.		
t_{ON}	Turn-On Time[6]	4.50 to 5.50	B0 or B1=V_{CC}, R_L=50Ω, C_L=35pF	1.0	12.0	25.0	1.0	30.0	ns	Figure 4
		3.00 to 3.60		5.0	15.0	30.0	3.0	35.0		
		2.30 to 2.70		5.0	20.0	35.0	5.0	40.0		
		1.65 to 1.95		10.0	50.0	70.0	10.0	75.0		
t_{OFF}	Turn-Off Time[6]	4.50 to 5.50	B0 or B1=V_{CC}, R_L=50Ω, C_L=35pF	1.0	9.5	20.0	1.0	25.0	ns	Figure 4
		3.00 to 3.60		1.0	9.0	20.0	1.0	25.0		
		2.30 to 2.70		2.0	10.0	20.0	2.0	25.0		
		1.65 to 1.95		2.0	28.0	40.0	2.0	50.0		
t_{BBM}	Break-Before-Make Time[6]	4.50 to 5.50	B0 or B1=V_{CC}, R_L=50Ω, C_L=35pF	1.0	10.0	12.0	0.1	14.0	ns	Figure 5
		3.00 to 3.60		1.0	14.0	16.0	1.0	17.0		
		2.30 to 2.70		1.0	21.0	25.0	1.0	27.0		
		1.65 to 1.95			35.0		2.0	50.0		
Q	Charge Injection	5.50	C_L=1.0nF, V_{GEN}=0V, R_{GEN}=0Ω		47				pC	Figure 7
		3.30			33					
		2.50			23					
		1.65			10					
OIRR	Off Isolation	1.8 to 5.0	f=1MHz, R_L=50Ω		-60				dB	Figure 6
Xtalk	Crosstalk	1.8 to 5.0	f=1MHz, R_L=50Ω		55				dB	Figure 6
BW	-3db Bandwidth	5.50	R_L=50Ω		60				MHz	Figure 9
		3.30			60					
		2.50			55					
		1.65			50					
THD	Total Harmonic Distortion	1.80	R_L=600Ω, V_{IN}=0.5V_{PP}, f=20Hz to 20kHz		.015				%	Figure 10
		5.00			.002					

Capacitance

Symbol	Parameter	V_{CC} (V)	Conditions	$T_{A=}$+25ºC			Unit
				Min.	Typ.	Max.	
C_{IN}	Control Pin Input Capacitance	0	f=1MHz		3.2		pF
C_{OFF}	B Port Off Capacitance	1.65 to 5.50	f=1MHz		50		pF
C_{ON}	A Port On Capacitance	1.65 to 5.50	f=1MHz		150		pF

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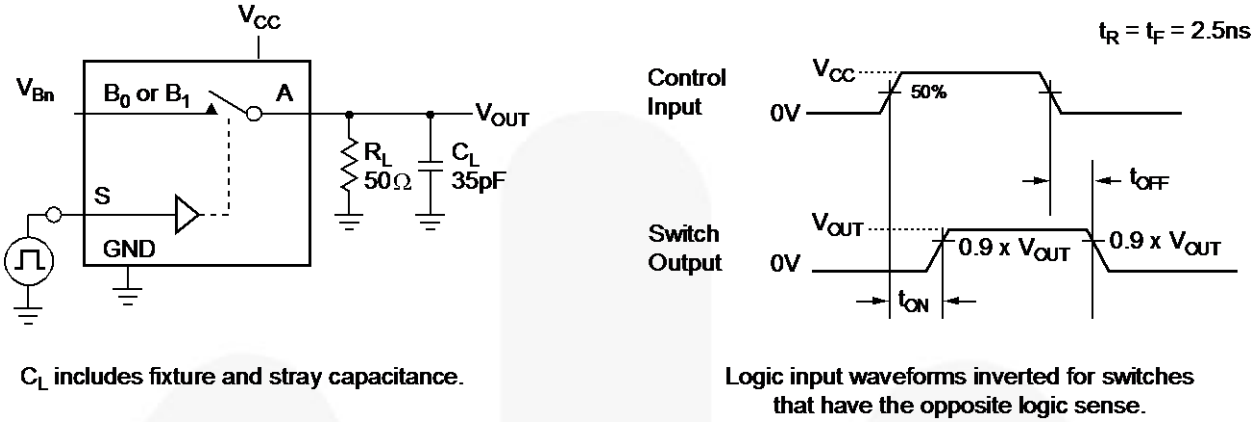
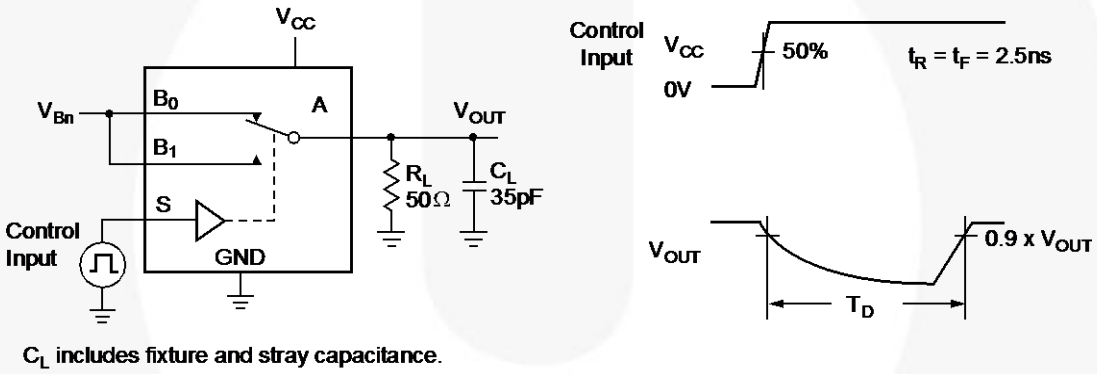
Test Diagrams



C_L includes fixture and stray capacitance.

Logic input waveforms inverted for switches that have the opposite logic sense.

Figure 4. Turn On / Off Timing



C_L includes fixture and stray capacitance.

Figure 5. Break-Before-Make Timing

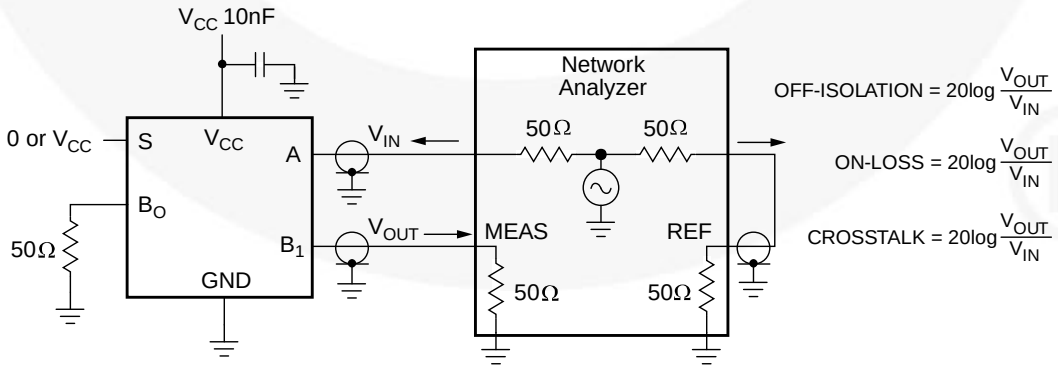


Figure 6. Off Isolation and Crosstalk

Test Diagrams (Continued)

Figure 7. Charge Injection

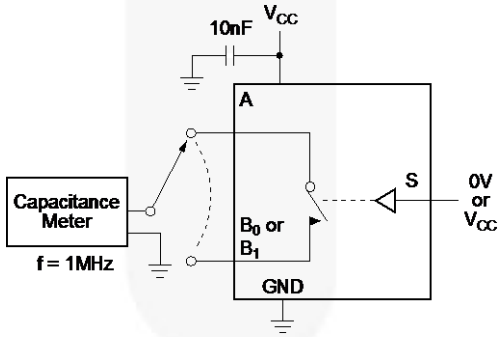


Figure 8. On / Off Capacitance Measurement Setup

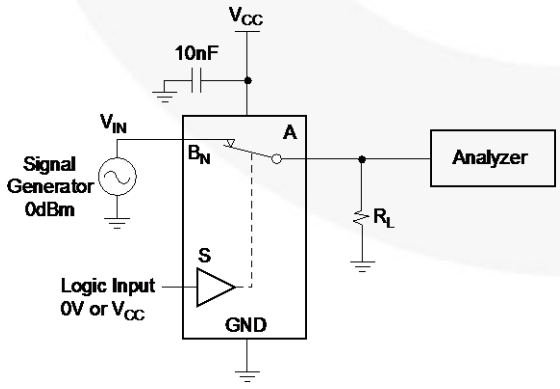


Figure 9. Bandwidth

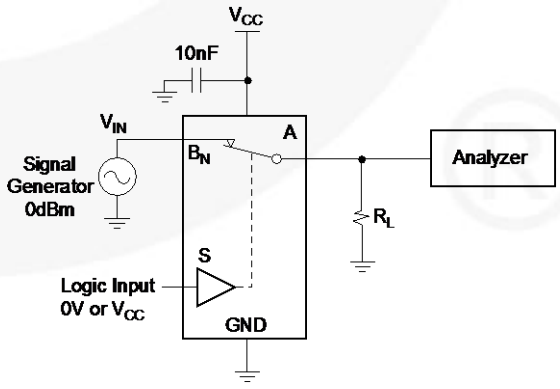
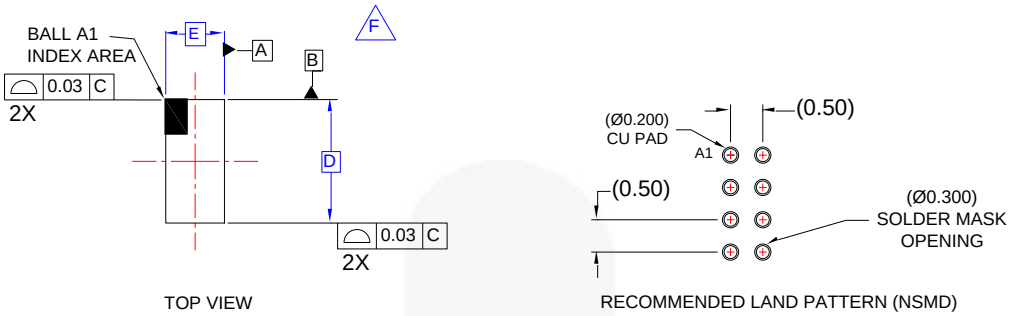
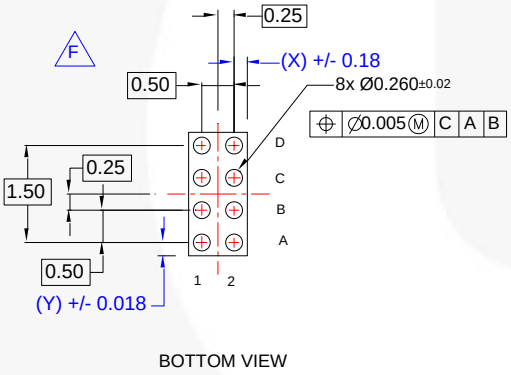


Figure 10. Harmonic Distortion

Physical Dimensions





NOTES:

A. NO JEDEC REGISTRATION APPLIES.

B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS AND TOLERANCE PER ASMEY14.5M, 1994.

D. DATUM C, THE SEATING PLANE IS DEFINED BY THE SPHERICAL CROWNS OF THE BALLS.

E. PACKAGE NOMINAL HEIGHT IS 586 MICRONS ±39 MICRONS (547-625 MICRONS).

F. FOR DIMENSIONS D, E, X, AND Y SEE PRODUCT DATASHEET.

G. BALL COMPOSITION: Sn95.5Ag3.9Cu0.6

H. DRAWING FILNAME: MKT-UC008ADrev2

Figure 11. 8-Ball, WLCSP 0.5mm Pitch

Table 1. Product Specific Dimensions

Product	D	E	X	Y
FSA859UCX	1.910	0.910	0.205	0.205

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

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ISOPLANAR™
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MillerDrive™
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TinyBuck™
TinyLogic®
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Datasheet Identification	Product Status	Definition
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Rev. I35

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