FC2129 CMOS Low Dropout Voltage (LDO) Regulator

CMOS Low Dropout Voltage Regulator

Description

The FC2129 series of positive, linear regulators feature low quiescent current (45μA typ.) with low dropout voltage, making them ideal for battery applications.
Output voltages are set at the factory and trimmed to 1.5% accuracy.
These rugged devices have both Thermal Shutdown, and Current Fold-back to prevent device failure under the "Worst" of operating conditions.
In applications requiring a low noise, regulated supply, place a 1000pF capacitor between Bypass and Ground.
The FC2129 is stable with an output capacitance of 4.7μF or greater.

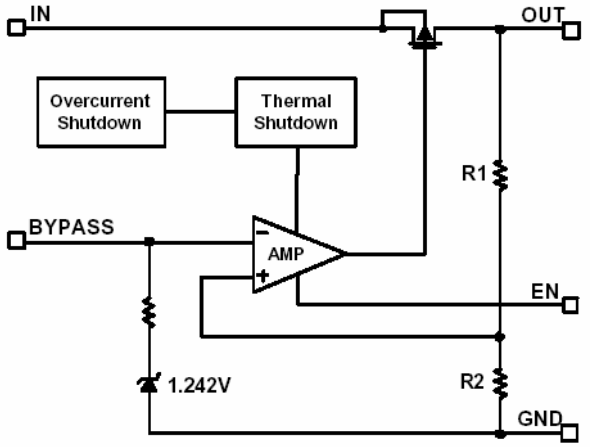
Features

- Very Low Dropout Voltage
- Guaranteed 1.55A output
- Over-Temperature Shutdown
- Current Limiting
- Highly Accurate± 1.5%
- Low Temperature Coefficient
- Noise Reduction Bypass Capacitor
- Power-Saving Shutdown Mode

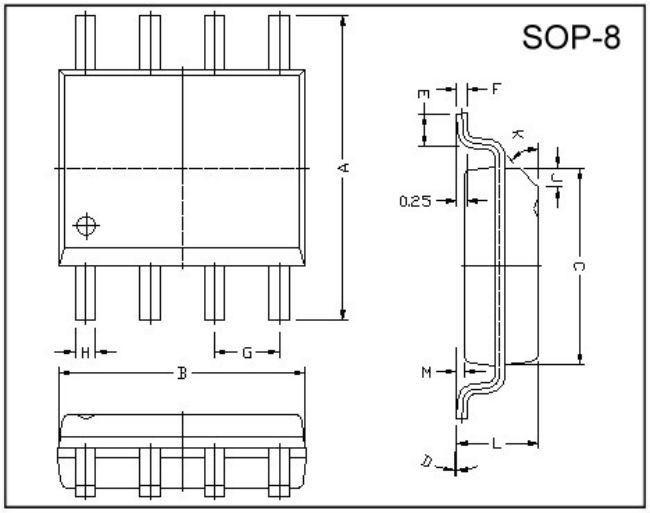
Applications

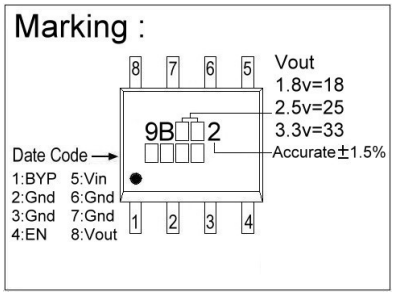
- Battery Powered Widgets
- Instrumentation
- Wireless Devices
- PC Peripherals
- Portable Electronics

Functional Block Diagram



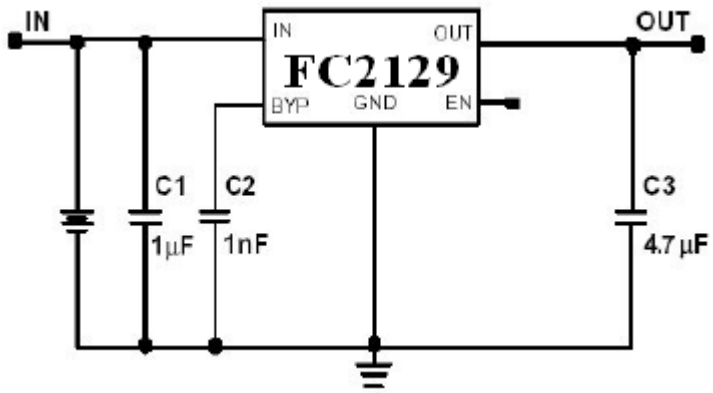
Package Dimensions





REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	5.80	6.20	M	0.10	0.25
B	4.80	5.00	H	0.35	0.49
C	3.80	4.00	L	1.35	1.75
D	0°	8°	J	0.375 REF.	
E	0.40	0.90	K	45°	
F	0.19	0.25	G	1.27 TYP.	

Typical Application Circuit



Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Input Max Voltage	V_{IN}	8	V
Output Current	I_{OUT}	$P_D/(V_{IN}-V_O)$	A
Output Voltage	V_{OUT}	1.5~5.0	V
Operating Ambient Temperature	Topr	-40 ~ +85	℃
Junction Temperature	Tj	-40 ~ +125	℃
Maximum Junction Temperature	$T_{j\,Max}$	150	℃
Thermal Resistance	θjc	20**	℃/W
Internal Power Dissipation(△T=100℃)*	PD	2.5	W
EDS Classification		B	

*Assuming a heat sink capable of twice times (θjc)

**Estimated

Electrical Characteristics $V_{IN}=V_{OUT}(T)+2V$, $V_{EN}=V_{IN}$, $T_A=25℃$ unless otherwise noted

Parameter	Symbol	Condition		Min	Typ	Max	Unit
Output Voltage	$V_{OUT}(E)$ (Note1)	I_O=1mA		-1.5%	$V_{OUT}(T)$ (Note2)	1.5%	V
Output Current	I_O	V_{OUT}>1.2V		1.55	-	-	A
Current Limit	I_{LIM}	V_{OUT}>1.2V		1.55	2.0	-	A
Load Regulation	REG_{LOAD}	I_O=1mA to 1.5A		-1	0.2	1	%
Dropout Voltage	$V_{DROPOUT}$	I_O=1.55A $V_O=V_{OUT}(E)$-2%	1.5V<$V_{OUT}(T)$≦2.0V	-	-	1000	mV
			2.0V<$V_{OUT}(T)$≦2.8V	-	-	800	
			2.8V<$V_{OUT}(T)$	-	-	600	
Quiescent Current	I_Q	I_O=0mA		-	45	70	μA
Ground Pin Current	I_{GND}	I_O=1mA~1.5A		-	45	-	μA
Line Regulation	REG_{LINE}	I_O=1mA $V_{IN}=V_{OUT}(T)+1$ to $V_{OUT}(T)+2$	$V_{OUT}(T)$<2.0V	-	-	0.15	%
			2.0V≦$V_{OUT}(T)$	-	0.02	0.1	
Input Voltage	V_{IN}			Note3	-	7	V
Over Temperature Shutdown	OTS			-	150	-	℃
Over Temperature Hysterisis	OTH			-	30	-	℃
Output Voltage Temperature Coefficient	TC			-	30	-	ppm/℃
Power Supply Rejection	PSRR	Io=100mA Co=4.7μF ceramic	f=1kHz	-	50	-	dB
			f=10kHz	-	20	-	
			f=100kHz	-	15	-	
Power Supply Rejection	PSRR	Io=100mA Co=4.7μF ceramic C_{BYP}=0.01μF	f=1kHz	-	75	-	dB
			F=10kHz	-	55	-	
			f=100kHz	-	30	-	
Output Voltage Noise	eN	f=10Hz~100kHz Io=10mA, C_{BYP}=0μF	Co=4.7μF	-	30	-	μVrms
Output Voltage Noise	eN	f=10Hz~100kHz Io=10mA, C_{BYP}=0.01μF	Co=4.7μF	-	30	-	μVrms
EN Input Threshold	V_{EH}	V_{IN}=2.7V to 7V		2.0	-	V_{IN}	V
	V_{EL}	V_{IN}=2.7V to 7V		0	-	0.4	V
EN Input Bias Current	I_{EH}	$V_{EN}=V_{IN}$, V_{IN}=2.7V to 7V		-	-	0.1	μA
	I_{EL}	V_{EN}= 0V, V_{IN}=2.7V to 7V		-	-	0.5	μA
Shutdown Supply Current	I_{SD}	V_{IN}=5.0V, V_O=0, $V_{EN}<V_{EL}$		-	30	-	μA
		V_{IN}=2.5V, V_O=0, $V_{EN}<V_{EL}$		-	0.5	2	μA

Note 1: V_{OUT} (E) =Effective Output Voltage (i.e. the output voltage when "V_{OUT} (T) + 2.0V" is provided at the VIN pin while maintaining a certain I_{OUT} value).

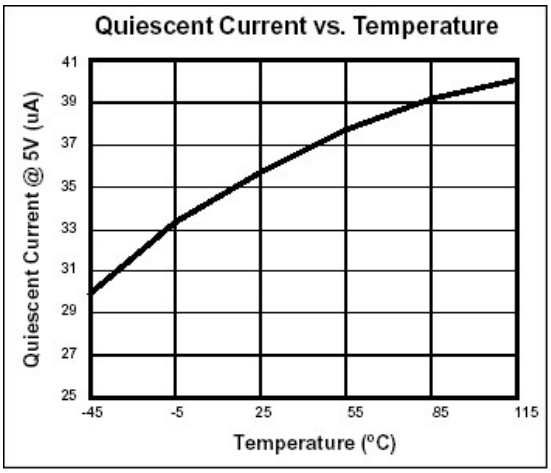
2: V_{OUT} (T) =Specified Output Voltage

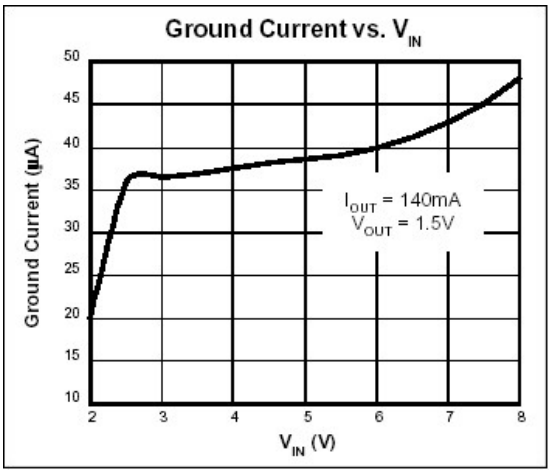
3: $V_{IN\ (MIN)} = V_{OUT} + V_{DROPOUT}$

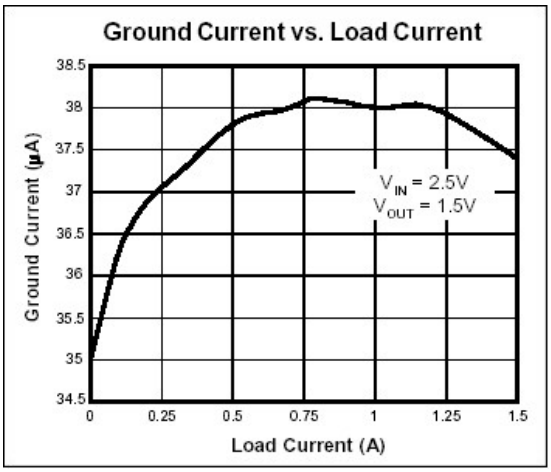
Ordering Information (contd.)

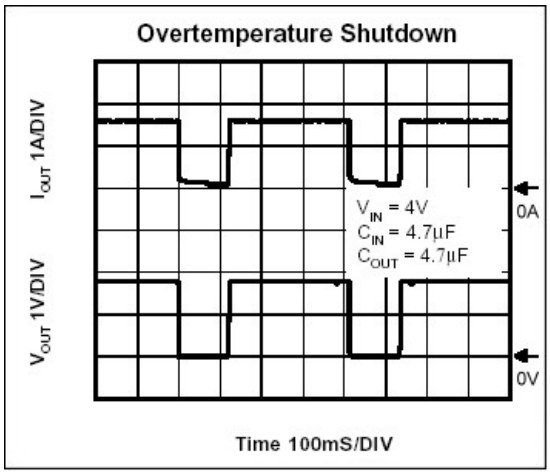
Part Number	Marking	Output Voltage	Part Number	Marking	Output Voltage
FC2129-15	9B152 XXXX	1.5V	FC2129-18	9B182 XXXX	1.8V
FC2129-25	9B252 XXXX	2.5V	FC2129-33	9B332 XXXX	3.3V
FC2129-47	9B472 XXXX	4.75V	FC2129-50	9B502 XXXX	5.0V

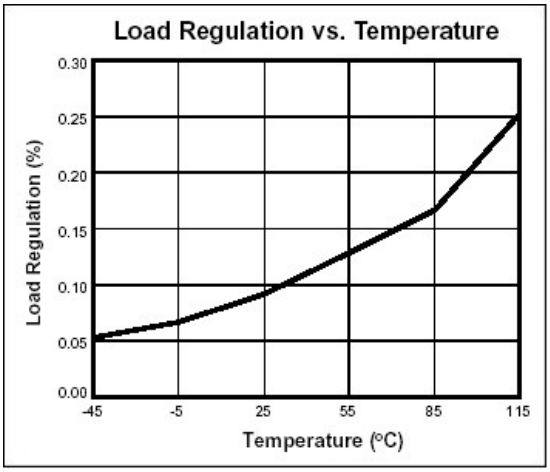
Characteristics Curve

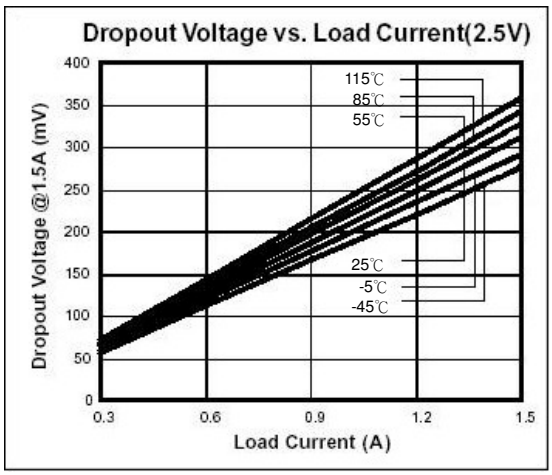


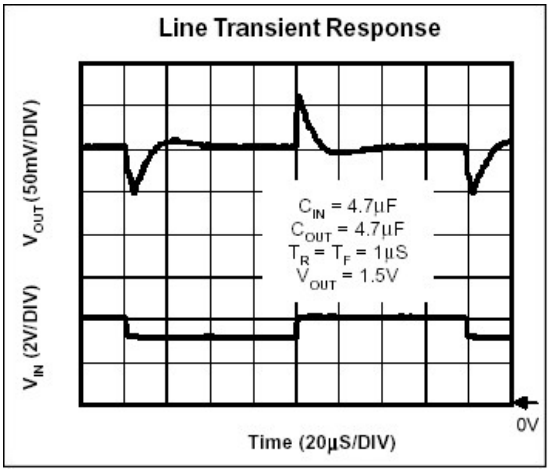


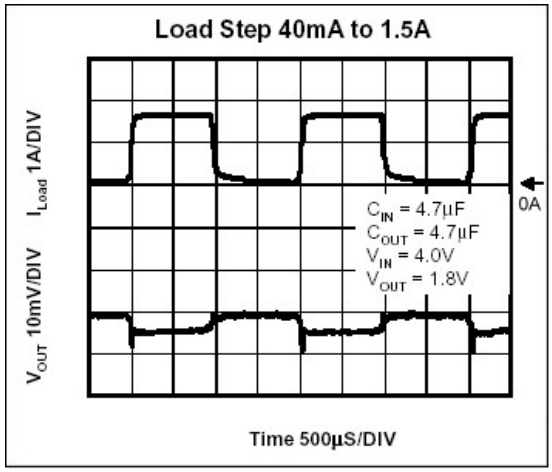


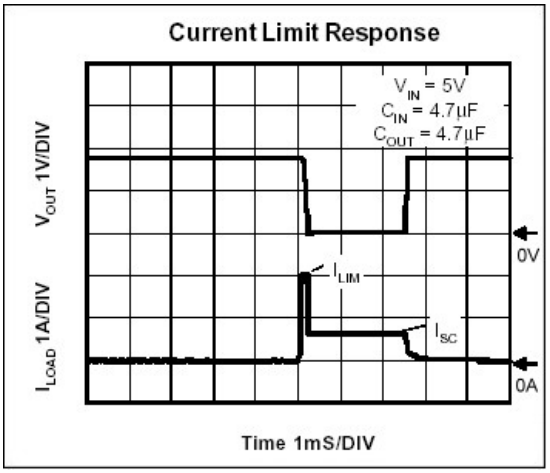


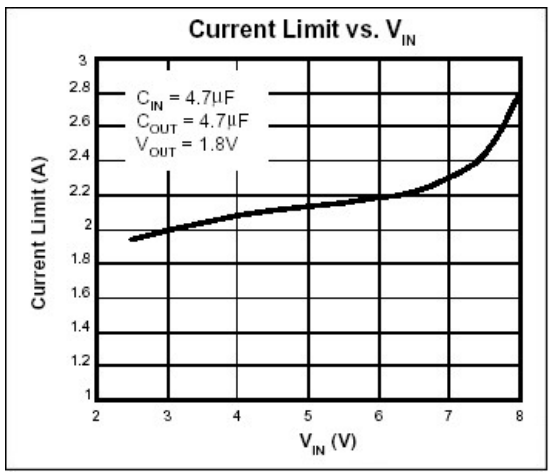

Load Regulation vs. Temperature
Load Regulation (%)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-45
-5
25
55
85
115
Temperature (°C)

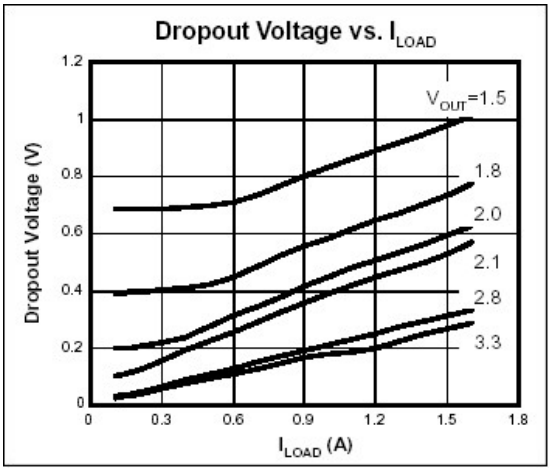

Dropout Voltage vs. Load Current(2.5V)
Dropout Voltage @1.5A (mV)
400
350
300
250
200
150
100
50
0
115℃
85℃
55℃
25℃
-5℃
-45℃
0.3
0.6
0.9
1.2
1.5
Load Current (A)

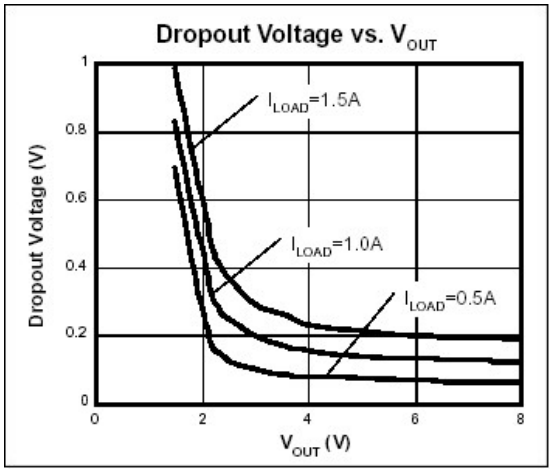

Line Transient Response
V_OUT (50mV/DIV)
V_IN (2V/DIV)
C_IN = 4.7µF
C_OUT = 4.7µF
T_R = T_F = 1µS
V_OUT = 1.5V
0V
Time (20µS/DIV)

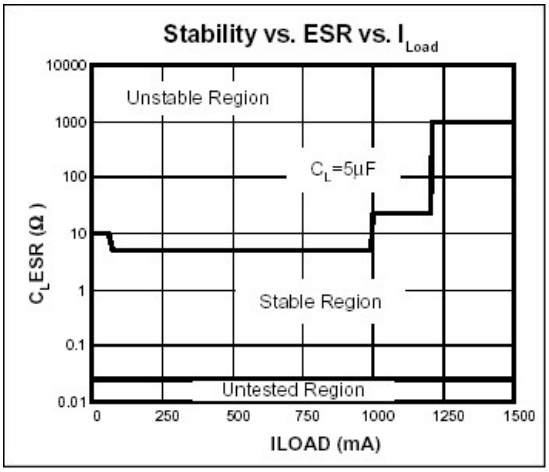

Load Step 40mA to 1.5A
I_Load 1A/DIV
V_OUT 10mV/DIV
C_IN = 4.7µF
C_OUT = 4.7µF
V_IN = 4.0V
V_OUT = 1.8V
0A
Time 500µS/DIV

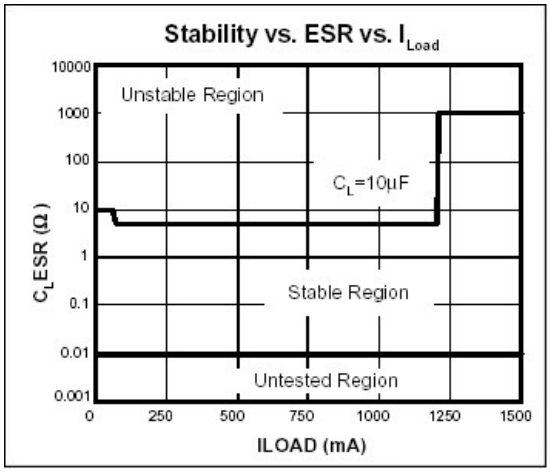

Current Limit Response
V_OUT 1V/DIV
I_LOAD 1A/DIV
V_IN = 5V
C_IN = 4.7µF
C_OUT = 4.7µF
I_LIM
I_SC
0V
0A
Time 1mS/DIV


Current Limit vs. V_IN
Current Limit (A)
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
C_IN = 4.7µF
C_OUT = 4.7µF
V_OUT = 1.8V
2
3
4
5
6
7
8
V_IN (V)


Dropout Voltage vs. I_{LOAD}
Dropout Voltage (V)
I_{LOAD} (A)
V_{OUT}=1.5
1.8
2.0
2.1
2.8
3.3


Dropout Voltage vs. V_{OUT}
Dropout Voltage (V)
V_{OUT} (V)
I_{LOAD}=1.5A
I_{LOAD}=1.0A
I_{LOAD}=0.5A


Stability vs. ESR vs. I_{Load}
C_LESR (Ω)
ILOAD (mA)
Unstable Region
C_L=5µF
Stable Region
Untested Region


Stability vs. ESR vs. I_{Load}
C_LESR (Ω)
ILOAD (mA)
Unstable Region
C_L=10µF
Stable Region
Untested Region

Detailed Description

The FC2129 series of COMS regulators contain a PMOS pass transistor, voltage reference, error amplifier, over-current protection, and thermal shutdown.

The P-channel pass transistor receives data from the error amplifier, over-current shutdown, and thermal protection circuits. During normal operation, the error amplifier compares the output voltage to a precision reference. Over-current and Thermal shutdown circuits become active when the junction temperature exceeds 140℃, or the current exceeds 2.2A. During thermal shutdown, the output voltage remains low. Normal operation is restored when the junction temperature drops below 120℃.

External Capacitors

The FC2129 is stable with an output capacitance to ground of 4.7μF or greater. Ceramic capacitors have the lowest ESR, and will offer the best AC performance. Conversely, Aluminum Electrolytic capacitors exhibit the highest ESR, resulting in the poorest AC response. Unfortunately, large value ceramic capacitors are comparatively expensive. One option is to parallel a 0.1μF ceramic capacitor with a 10μF Aluminum Electrolytic. The benefit is low ESR, high capacitance, and low overall cost.

A second capacitor is recommended between the input and ground to stabilize Vin. The input capacitor should be at least 0.1μF to have a beneficial effect.

A third capacitor can be connected between the BY-PASS pin and GND. This capacitor can be a low cost Polyester Film variety between the value of 0.001~0.01μF. A large capacitor improves the AC ripple rejection, but also makes the output come up slowly. This “Soft” turn-on is desirable in some applications to limit turn-on surges.

All capacitors should be placed in close proximity to the pins. A “Quiet” ground termination is desirable. This can be achieved with a “Star” connection.

Enable

When pulled low, the PMOS pass transistor shuts off, and all internal circuits are powered down. In this state, the quiescent current is less than 1μA. This pin behaves much like an electronic switch.