

Protection of Lithium Ion Batteries

Monolithic IC MM1414

Outline

This IC is used to protect lithium-ion batteries consisting of three or four cells. It adopts a compact package and has the functions of previous models, with functions for overcharge detection, overdischarge detection and overcurrent detection. A dead time can be set externally.

Features

1. Overcharge detection voltage accuracy $\pm 25\text{mV/cell}$
2. Consumption current ($V_{\text{cell}}=4.4\text{V}$) $50\mu\text{A typ.}$
3. Consumption current ($V_{\text{cell}}=3.5\text{V}$) $23\mu\text{A typ.}$
4. Consumption current ($V_{\text{cell}}=1.8\text{V}$) $2\mu\text{A typ.}$
5. Overcharge sensing dead time: can be set externally
6. PF detection: warning signal when cell voltage falls

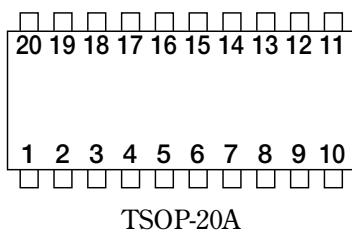
Package

TSOP-20A

Applications

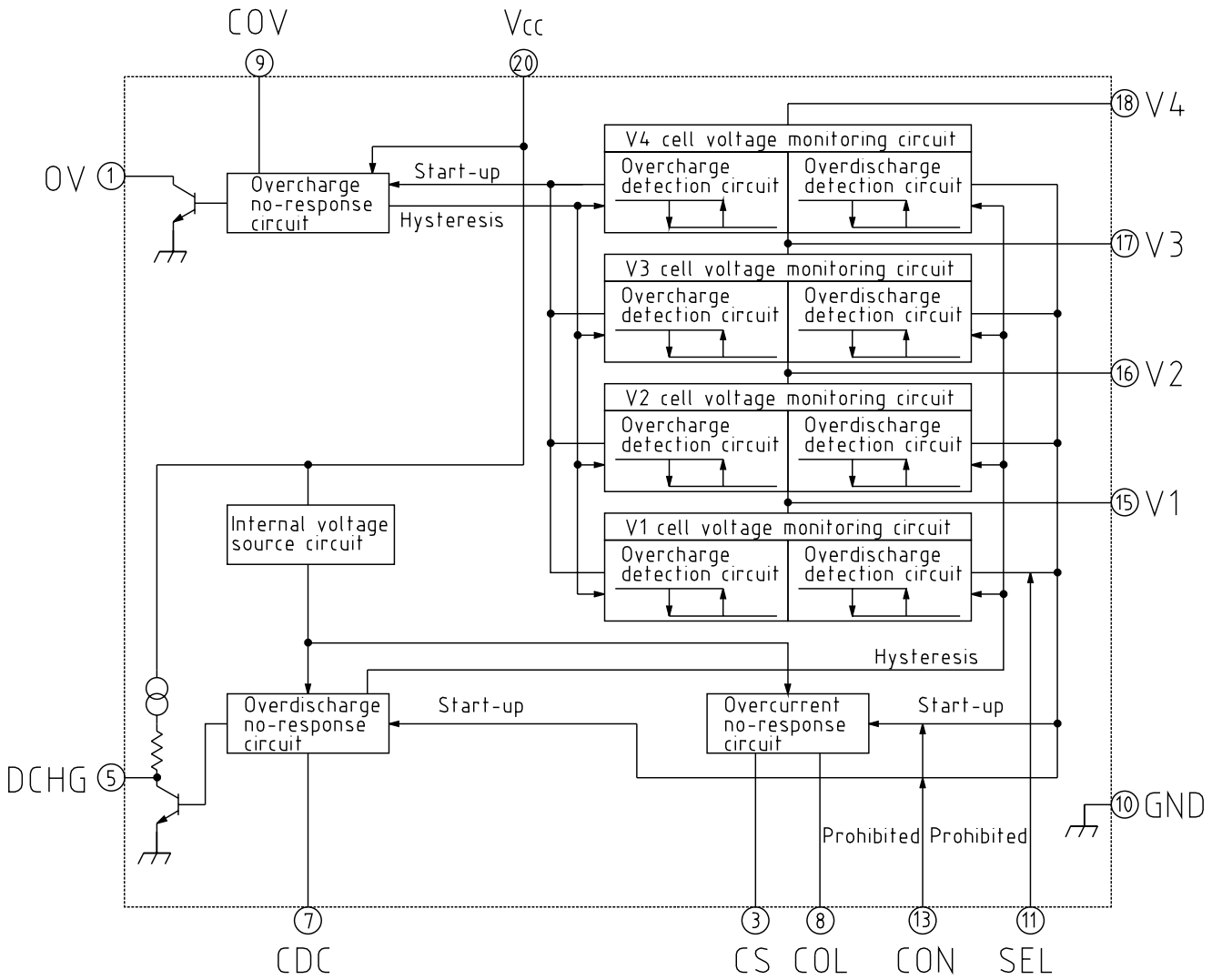
IC for protection of lithium-ion batteries consisting of three or four cells

Pin Assignment



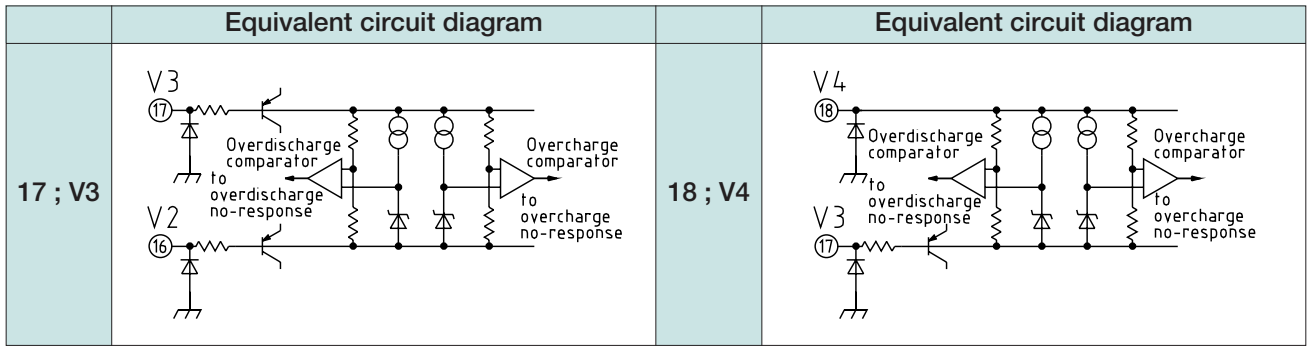
1	OV	11	SEL
2	N.C	12	N.C
3	CS	13	CON
4	N.C	14	N.C
5	DCHG	15	V1
6	N.C	16	V2
7	CDC	17	V3
8	COL	18	V4
9	COV	19	N.C
10	GND	20	V _{CC}

Block Diagram



Pin Description

	Equivalent circuit diagram		Equivalent circuit diagram
1 ; OV		9 ; COV	
3 ; CS		11 ; SEL	
5 ; DCHG		13 ; CON	
7 ; CDC		15 ; V1	
8 ; COL		16 ; V2	



Absolute Maximum Ratings (Ta=5°C)

Item	Symbol	Ratings	Unit
Storage temperature	T _{STG}	-40~+125	°C
Operating temperature	T _{OPR}	-20~+70	°C
Power supply voltage	V _{CC} max.	-0.3~24	V
OV pin impressed voltage	V _{OV} max.	-0.3~24	V
SEL pin impressed voltage	V _{SEL} max.	-0.3~24	V
CON pin impressed voltage	V _{CON} max.	-0.3~24	V
Allowable loss	P _d	300	mW

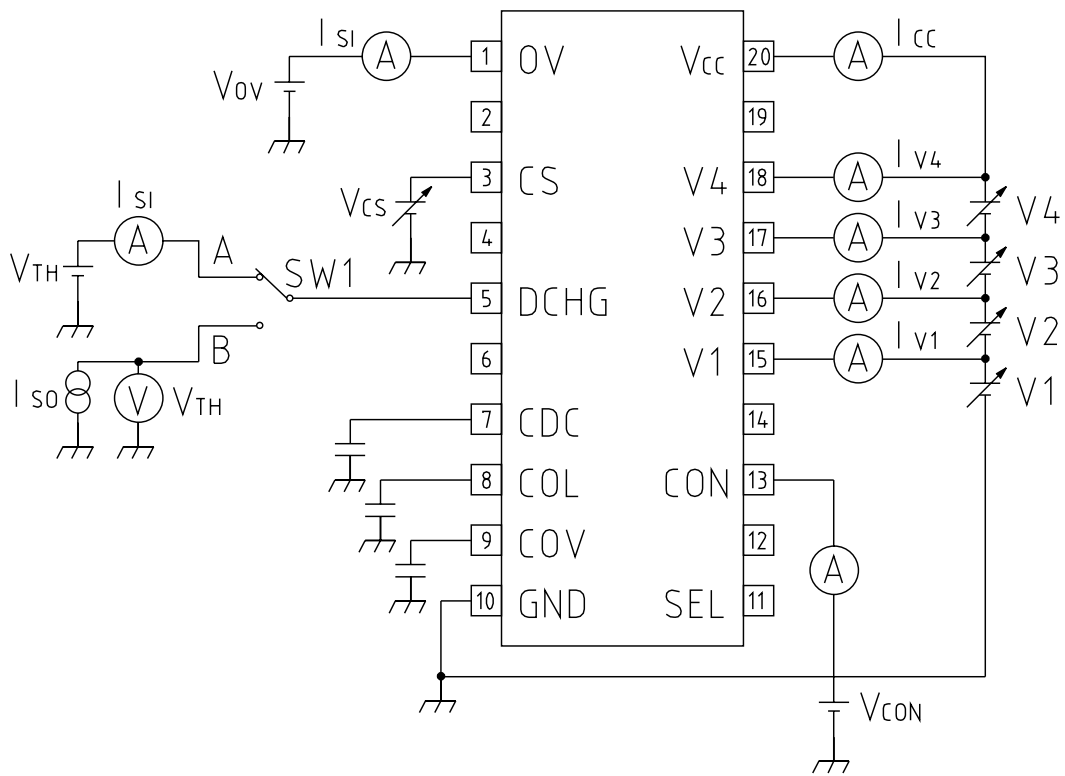
Recommended Operating Conditions

Item	Symbol	Ratings	Unit
Operating temperature	T _{OPR}	-20~+70	°C
Operating voltage	V _{OPR}	+1.8~+24	V

Electrical Characteristics (Except where noted otherwise, Ta=25°C, Vcc=V4+V3+V2+V1, Vcell=3.5V, CON=0V, SEL=0V)

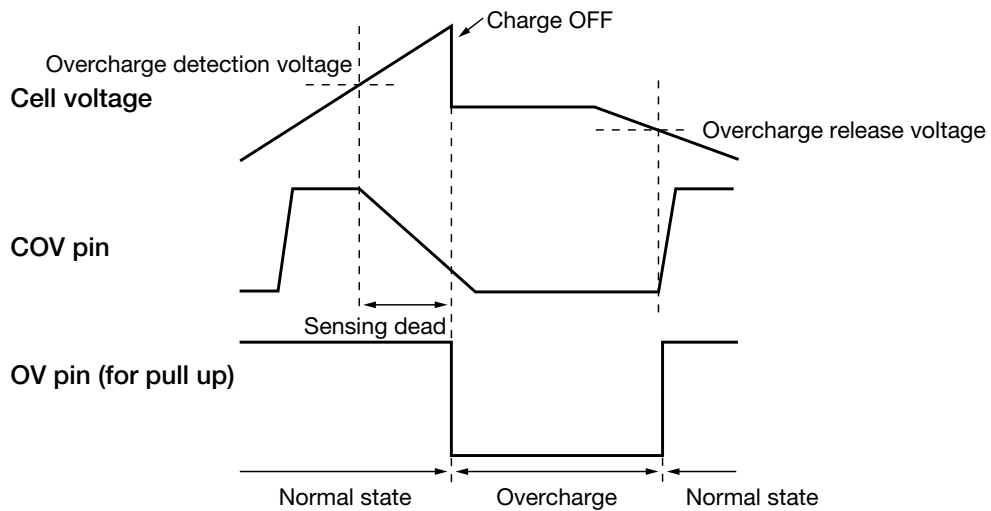
Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Unit	
Consumption current (Vcc pin) 1	Icc1	VCELL=4.4V, CON=0V		55	110	μA	
Consumption current (Vcc pin) 2	Icc2	VCELL=3.5V, CON=0V		27	50	μA	
Consumption current (Vcc pin) 3	Icc3	VCELL=1.8V, CON=0V		2	4	μA	
Consumption current (Vcc pin) 4	Icc4	VCELL=3.5V, CON=Vcc		12	20	μA	
Consumption current (Vcc pin) 5	Icc5	VCELL=1.8V, CON=Vcc		1	2	μA	
Consumption current (V4 pin) 1	I1V4	VCELL=4.4V		10	20	μA	
Consumption current (V4 pin) 2	I2V4	VCELL=3.5V		8	15	μA	
Consumption current (V4 pin) 3	I3V4	VCELL=1.8V		2.5	5.0	μA	
V3 pin input current	IV3	VCELL=3.5V			±300	nA	
V2 pin input current	IV2	VCELL=3.5V			±300	nA	
V1 pin input current	IV1	VCELL=3.5V			±300	nA	
Overcharge detection voltage	VCELLU	VCELL : 4.2V→4.4V	A, C	4.325	4.350	4.375	V
			B, D	4.225	4.250	4.275	
Overcharge hysteresis voltage	ΔVU	VCELL : 4.2V→4.4V→3.9V	140	200	260	mV	
Overcharge sensing dead time	tOV	COV=0.1μF	0.5	1.0	1.5	S	
Overdischarge detection voltage	VCELLS	VCELL : 3.5V→1.8V	A, B	1.90	2.00	2.10	V
			C, D	2.20	2.30	2.40	
Discharge resume voltage	VCELLD	VCELL : 1.8V→3.5V	2.85	3.00	3.15	V	
Overdischarge hysteresis voltage	ΔVDS	VCELLD-VCELLS	A, B	0.75	1.00	1.25	V
			C, D	0.45	0.70	0.95	
Overdischarge sensing dead time	tCDC	CDC=0.1μF	0.5	1.0	1.5	S	
Overcurrent detection voltage	VOC	Vcc-Vcs, DCHG	135	150	165	mV	
Overcurrent hysteresis voltage	ΔVOC			20	40	mV	
Overcurrent sensing dead time 1	tCOL1	COL=0.001μF	5	10	15	mS	
Overcurrent sensing dead time 2	tCOL2	COL=0.001μF, Vcc-CS>1.0V		1.5	3.0	mS	
Overcurrent sensing dead time 3	tCOL3	COL=0.001μF	5	10	15	mS	
Overcurrent reset conditions			Load release conditions 500kΩ				
DCHG pin source current	IsoDCH	VCELL=1.8V, SW1 : A VDCHG=Vcc-0.8V	20			μA	
DCHG pin sink current	IsiDCH	VCELL=3.5V, SW1 : A VDCHG=0.8V	20			μA	
DCHG pin output voltage H	VTHDcH	Vcc-VDCHG, Iso=20μA, SW1 : B			0.8	V	
DCHG pin output voltage L	VTHDcL	VDCHG-GND, Isi=-20μA, SW1 : B			0.8	V	
OV pin sink current	IsiOV	VOV=0.4V, Ta=-20~+70°C	100			μA	
OV pin leak current	ILROV	VOV=24V			0.1	μA	
CON pin L voltage		DCHG= "High"			0.4	V	
CON pin H voltage		DCHG= "Low"	Vcc-0.4			V	
CON pin current		VCELL=3.5V, CON=0.4V		1	2	μA	
SEL pin L voltage		for 3 cell			0.4	V	
SEL pin H voltage		for 4 cell	Vcc-0.4			V	
SEL pin current		VCELL=3.5V, SEL=0.4V		1	2	μA	

Measuring Circuit

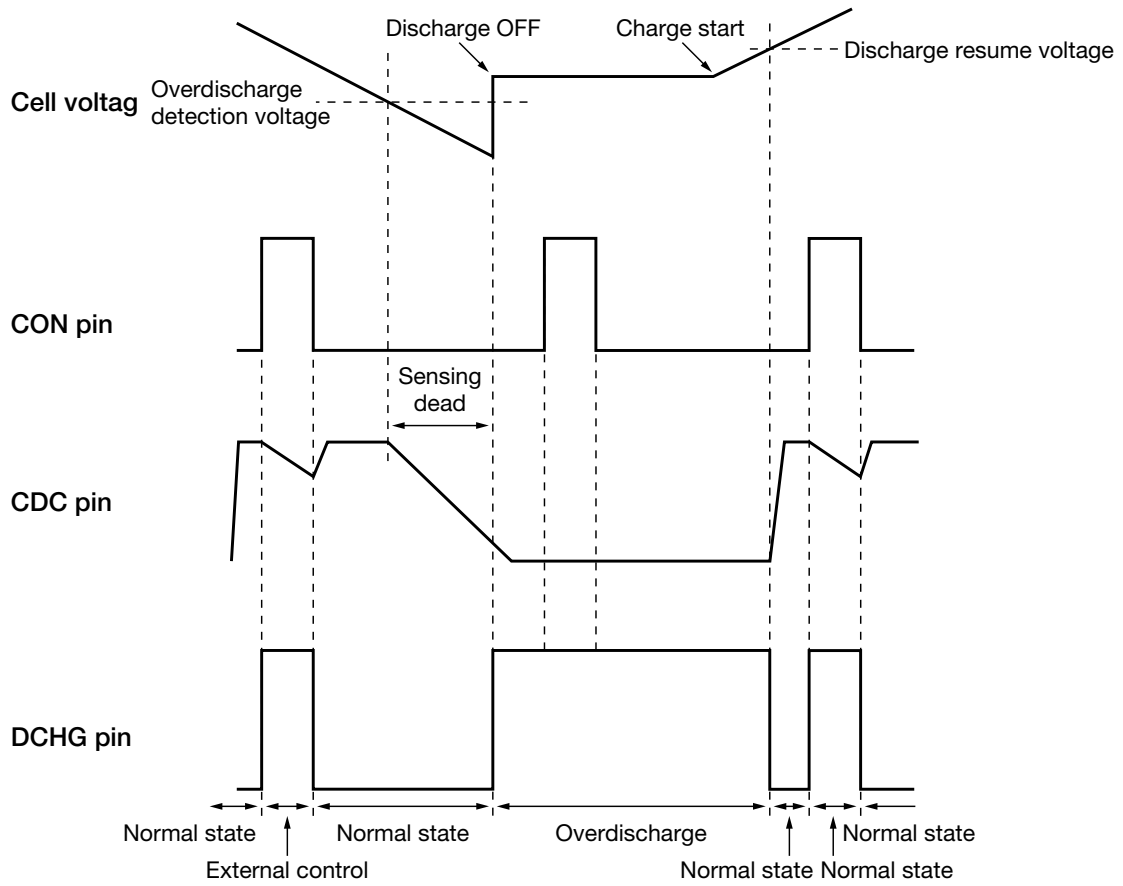


Timing Chart

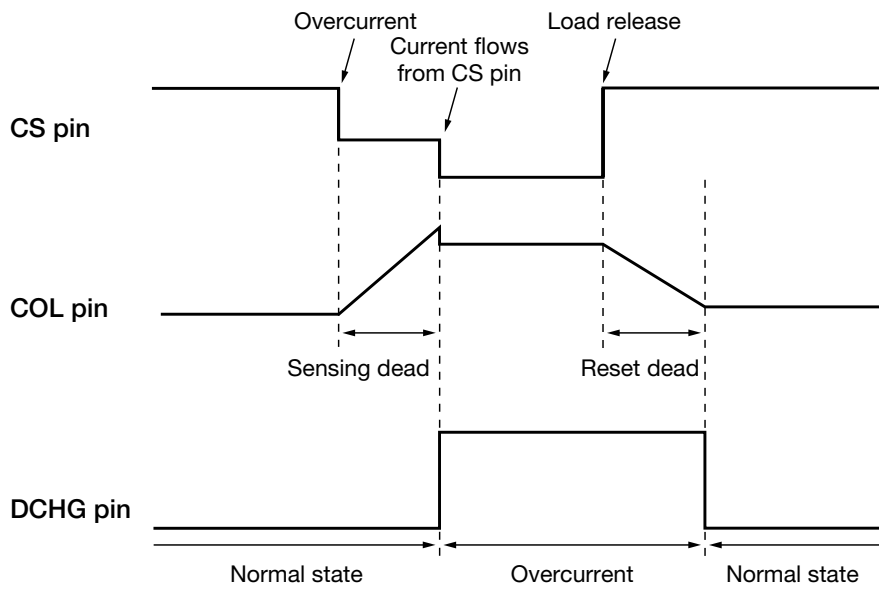
■ For overcharge



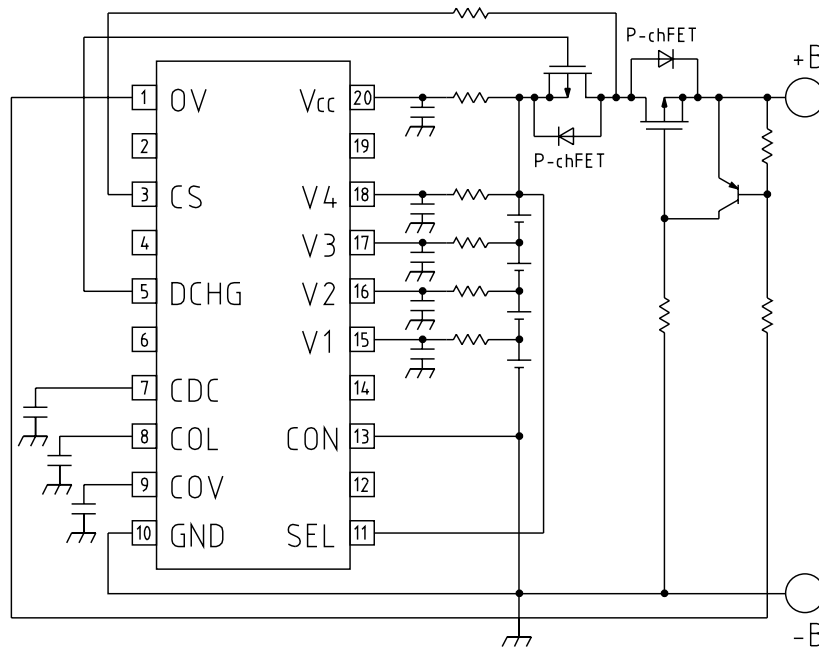
■ For overdischarge



■ For overcurrent

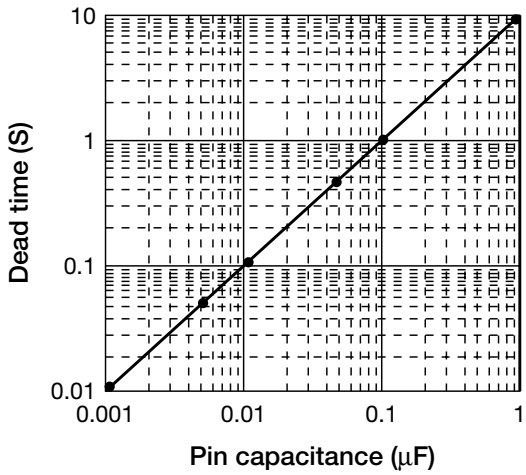


Application Circuit

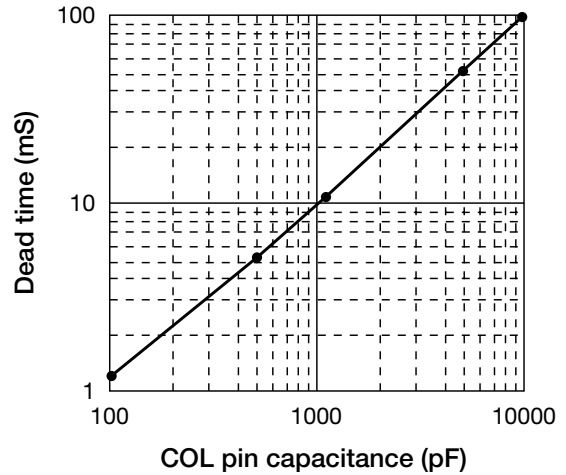


Characteristics

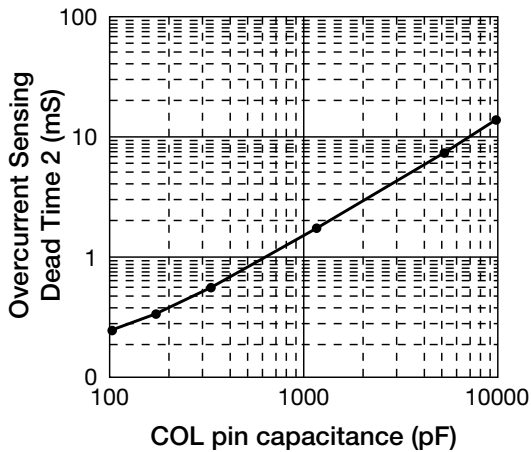
Overcharge & Overdischarge Sensing Dead Times



Overcurrent Sensing Dead Time 1, Overcurrent Reset Dead Time



Overcurrent Sensing Dead Time 2



Note: The above characteristics are representative values only, and are not guaranteed.