Ordering number : ENA2031

SANYO Semiconductors
DATA SHEET

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LC709201F — CMOS IC Battery Monitor IC

Overview

The LC709201F is an IC that measures the remaining power level of 1-cell lithium-ion secondary batteries by monitoring the battery voltage without an external sense resistor, and detects the remaining battery power level by current prediction. It monitors the battery voltage and realizes a function that precisely measures the remaining battery charge.
In addition, the IC realizes the function for calculating the remaining battery power level even more accurately by utilizing a temperature correction function that makes use of the temperature input from a thermistor.

Features

■Accuracy of remaining battery power level measurement
- Accuracy of ±5% during discharging from 100% to 0% (at an ambient operating temperature of 0°C to 50°C)

■Measurement of remaining battery power level
- The remaining power level is measured four times a second and calculated with each measurement undertaken.

■Interface
- I^2Cbus, communication in slave mode up to 100kHz supported

■Ports

• I^2C-bus communication pin	2 (SDA, SCL)
• Battery temperature reading control pin	1 (TSW)
• Analog voltage input pin for battery temperature	1 (TSENSE)
• Reset pin	1 (RESB)
• TEST pin	1 (TEST)
• Power supply pin	2 (V_{SS}, V_{DD})

■Package form
- MFP10S (225 mil): LC709201FM-01/02/03
- VCT16 (2.6×2.6): LC709201FRD-01/02/03

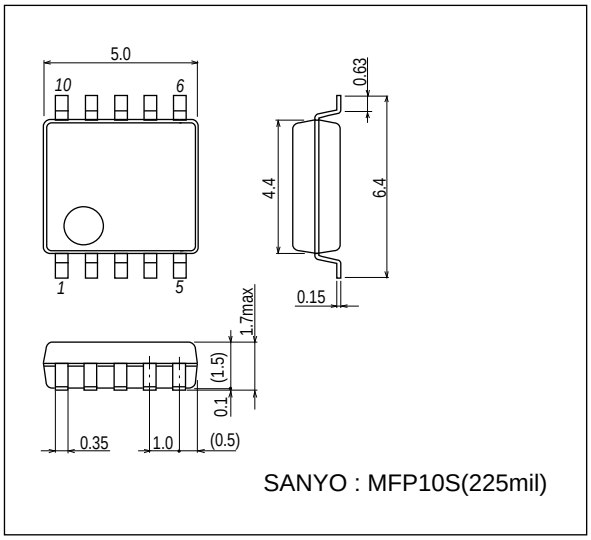
Applications

- Cell phones, PDA devices, MP3 players, cordless phones, digital cameras, USB-related devices, etc.

(Note) Depending on the kinds of battery, applicable model differs (LC709201F-01/02/03).
Please contact us for more detail information.

Package Dimensions

unit : mm (typ)
3086B



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unit : mm (typ)
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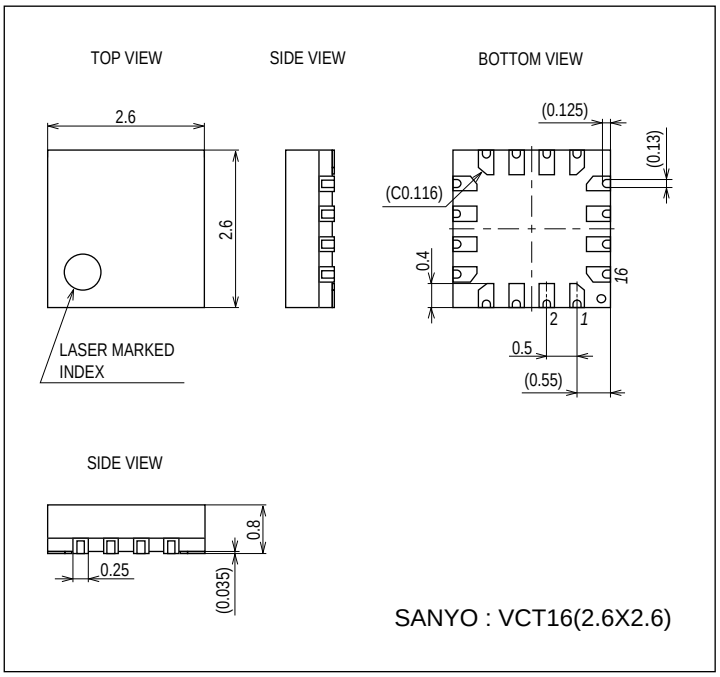
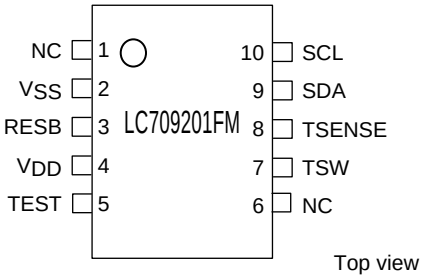
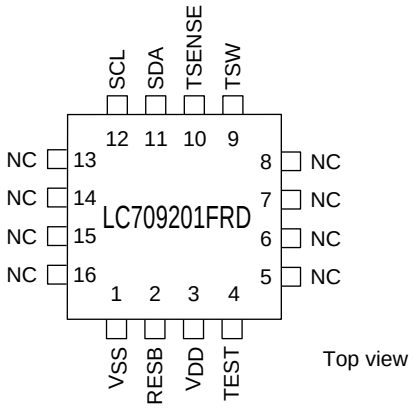


Pin Assignment

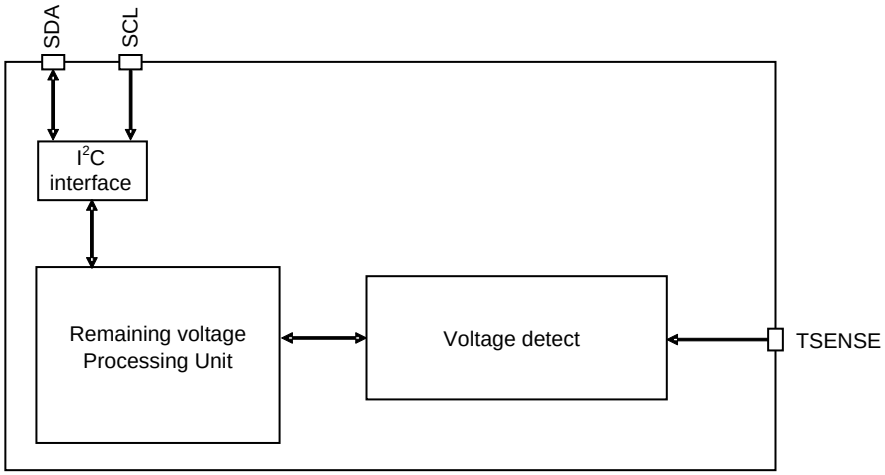


SANYO: MFP10S (225mil) “Lead-free Type”



SANYO: VCT16 (2.6×2.6) “Lead-free Type”

Block Diagram



Pin Function

Pin Name	I/O	Description
V_{SS}	-	- power pin
V_{DD}	-	+ power pin
RESB	I	Reset pin
TEST	I/O	Test pin *Connect an external 100kΩ pull-down resistor.
SDA	I/O	I^2C data pin
SCL	I/O	I^2C clock pin
TSW	O	Battery temperature reading control pin *Set high when reading in the temperature, held low at other times.
TSENSE	I	Battery temperature analog voltage input pin

Absolute Maximum Ratings at Ta=25°C, V_{SS}=0V

Parameter	Symbol	Pin/Remarks	Conditions		Specification			Unit
				V_{DD}[V]	min	typ	max	
Maximum supply voltage	V_{DD} max	V_{DD}			-0.3		+6.5	V
Input voltage	V_I (1)	RESB, TSENSE			-0.3		V_{DD} +0.3	
Output voltage	V_O (1)	TSW			-0.3		V_{DD} +0.3	
Input/output voltage	V_{IO} (1)	SDA, SCL, TEST			-0.3		V_{DD} +0.3	
Allowable power dissipation	Pd max	MFP10S	Ta=-40 to +85°C				110	mW
		VCT16					55	
Operating ambient temperature	Topr				-40		+85	°C
Storage ambient temperature	Tstg				-55		-125	

Allowable Operating Conditions at Ta=-40 to +85°C, V_{SS}=0V

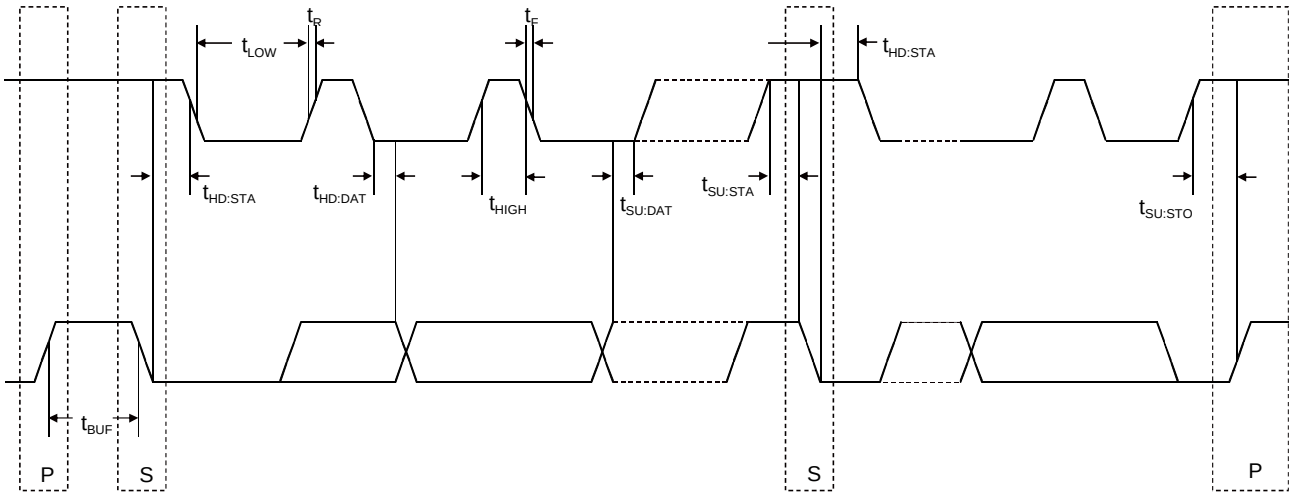
Parameter	Symbol	Pin/Remarks	Conditions		Specification			unit
				V_{DD}[V]	min	typ	max	
Operating supply voltage	V_{DD} (1)	V_{DD}			2.25		5.5	V
High level input voltage	V_{IH} (1)	SDA, SCL		2.25 to 5.5	0.3V_{DD} +0.7		V_{DD}	
Low level input voltage	V_{IL} (1)	SDA, SCL		4.0 to 5.5	V_{SS}		0.1V_{DD} +0.4	
	V_{IL} (2)			2.25 to 4.0	V_{SS}		0.2V_{DD}	

Electrical Characteristics at Ta=-40 to +85°C, V_{SS}=0V

Parameter	Symbol	Pin/Remarks	Conditions		Specification			Unit
				V_{DD}[V]	min	typ	max	
High level input current	I_{IH} (1)	RESB, SDA, SCL	V_{IN}=V_{DD} (including output transistor off leakage current)	2.25 to 5.5			1	µA
Low level input current	I_{IL} (1)	RESB, SDA, SCL	V_{IN}=V_{SS} (including output transistor off leakage current)	2.25 to 5.5	-1			
High level output voltage	V_{OH} (1)	TSW	I_{OH}=-0.4mA	3.0 to 5.5	V_{DD}-0.4			V
	V_{OH} (2)		I_{OH}=-0.2mA	2.25 to 5.5	V_{DD}-0.4			
Low level output voltage	V_{OL} (1)	TSW, SDA, SCL	I_{OL}=3.0mA	3.0 to 5.5			0.4	
	V_{OL} (2)		I_{OL}=1.3mA	2.25 to 5.5			0.4	
Hysteresis voltage	VHYS	RESB, SDA, SCL		2.25 to 5.5		0.1V_{DD}		
Pin capacitance	CP	All pins	Pins other than the pin under test V_{IN}=V_{SS} f=1 MHz Ta=25°C	2.25 to 5.5		10		pF
Consumption current	I_{DD} (1)	V_{DD}	When detecting remaining capacity	2.25 to 5.5		8	16	µA
	I_{DD} (2)		When not detecting remaining capacity	2.25 to 5.5		5	12	

I^2C Slave Characteristics at Ta=-40 to+85°C, V_{SS}=0V

Parameter	Symbol	Pin/Remarks	Conditions	V_{DD}[V]	Specification min	typ	max	unit
Clock frequency	TSCL	SCL		2.25 to 5.5			100	kHz
Bus free time between STOP condition and START condition	TBUF	SCL, SDA	See Fig. 1.		4.7			µs
Hold time (repeated) START condition First clock pulse is generated after this interval	THD: STA	SCL, SDA	See Fig. 1.		4.0			µs
Repeated START condition setup time	TSU: STA	SCL, SDA	See Fig. 1.		4.7			µs
STOP condition setup time	TSU: STO	SCL, SDA	See Fig. 1.		4.0			µs
Data hold time	THD: DAT	SCL, SDA	See Fig. 1.		300			ns
Data setup time	TSU: DAT	SCL, SDA	See Fig. 1.		250			ns
Clock low period	TLOW	SCL			4.7			µs
Clock high period	THIGH	SCL			4.0			µs
Clock/data fall time	TF	SCL, SDA					300	ns
Clock/data rise time	TR	SCL, SDA					1000	ns



Discharge Characteristics

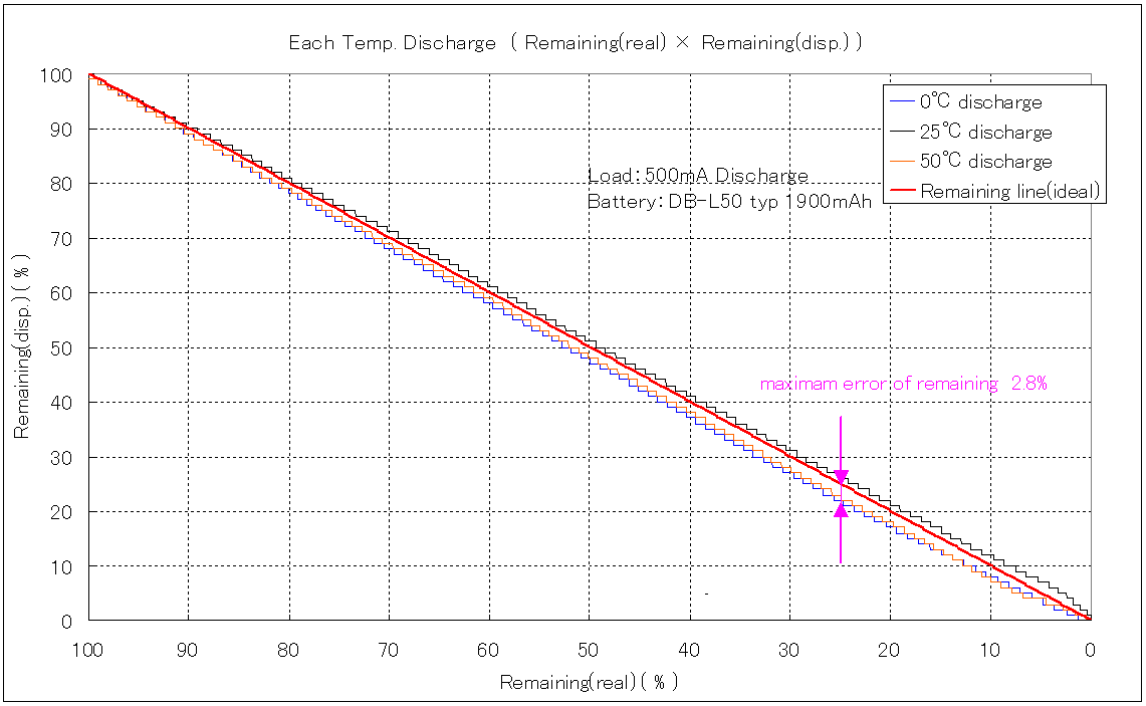


Figure2 Discharge Characteristics by Temperature Change

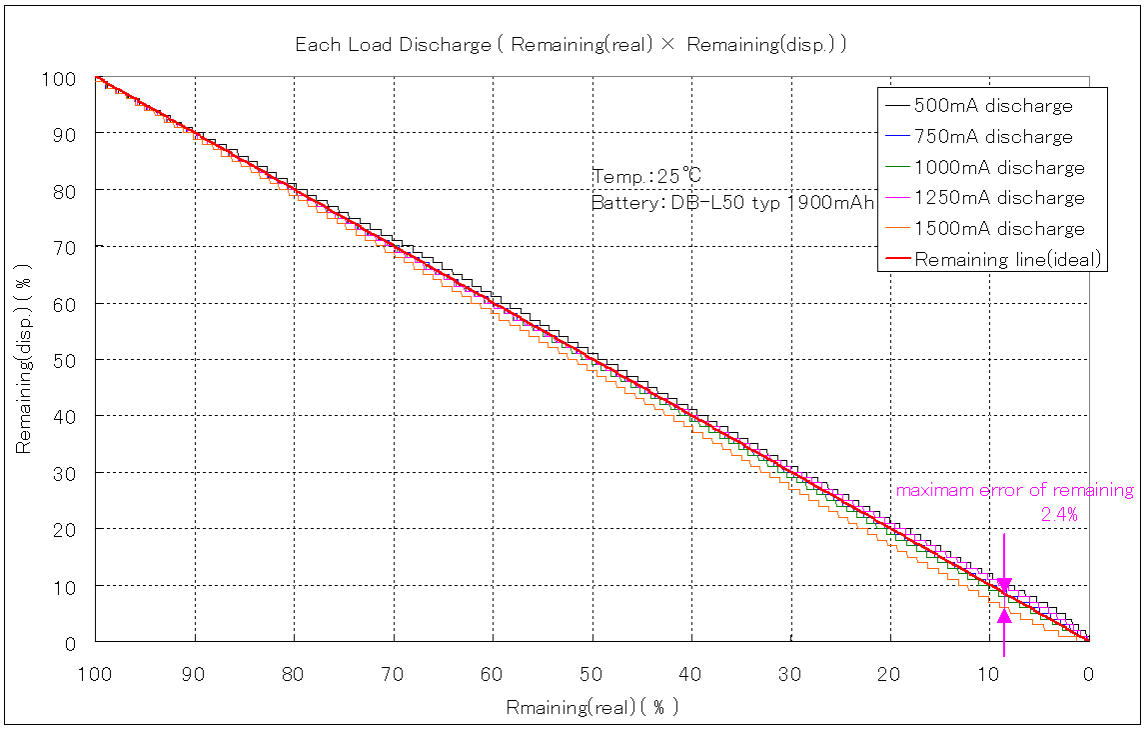


Figure 3 Discharge Characteristics by Load Change

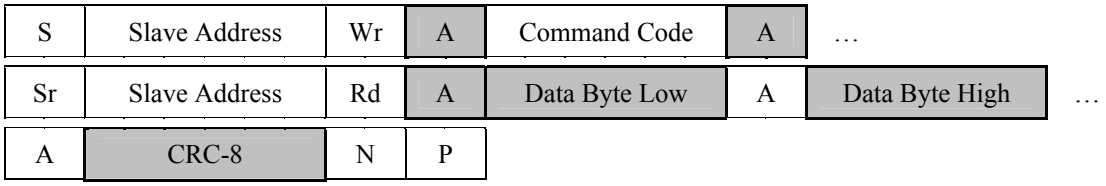
Communication Protocol

Communication protocol type: I^2C
Frequency: 100kHz
Address: 0x16

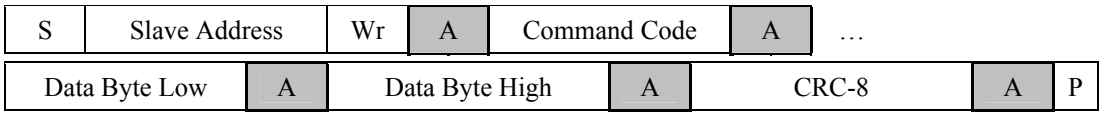
Bus Protocols

S	:	Start Condition
Sr	:	Repeated Start Condition
Rd	:	Read (bit value of 1)
Wr	:	Write (bit value of 0)
A	:	ACK (bit value of 0)
N	:	NACK (bit value of 1)
P	:	Stop Condition
CRC-8	:	Slave Address to Last Data (ex.3778mV: 0x16, 0x09, 0x17, 0xC2, 0x0E → 0x86)
	:	Master-to-Slave
	:	Slave-to-Master
…	:	Continuation of protocol

Read Word Protocol



Write Word Protocol



Slave Functions	Command Code	Range	Access	Unit
Cell Temperature	0x08	0 to 65535	R	0.1°K
Cell Voltage	0x09	0 to 65535	R	mV
Current	0x0A	-32768 to 32767	R	mA
Adjustment Pack	0x0B	0 to 255	R	Value
Relative State Of Charge	0x0D	0 to 100	R	%
Remaining Capacity	0x0F	0 to 65535	R	mAh
Full Charge Capacity	0x10	0 to 65535	R	mAh
IC Version	0x11	0 to 65535	R	Version
Adjustment Thermistor	0x12	0 to 255	R	Value
Set Relative State Of Charge	0x08	0xA500 + 0 to 100	W	0xA500 + %
Adjustment Pack	0x08	0x5A00 + 0 to 255	W	0x5A00 + Value
Adjustment Thermistor	0x08	0xAA00 + 0 to 255	W	0xAA00 + Value
Initial Relative State Of Charge	0x09	0xAA55	W	-

Application Circuit Example

Figure 4 Example of an application schematic using LC709201F

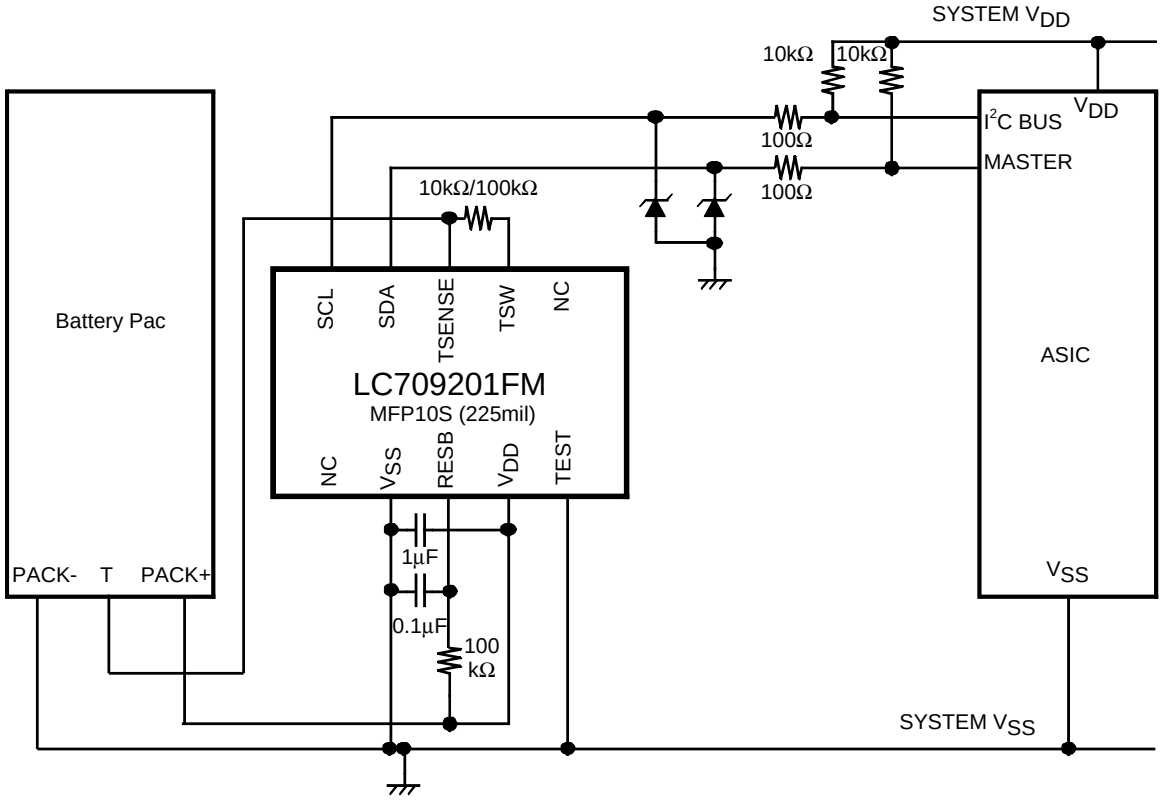


Figure 5 Conceptual diagram using LC709201F