LAMPIRAN- LAMPIRAN

Lampiran 1. DataSheet Baterai Lithium Ion ICR 16850

SAMSUNG SDI Confidential Proprietary.

Spec. No.	ICR18650-22F	Version No.	Tentative

1. Scope

This product specification has been prepared to specify the rechargeable lithium-ion cell ('cell') to be supplied to the customer by Samsung SDI Co., Ltd.

2. Description and Model

2.1 Description Cell (lithium-ion rechargeable cell)

2.2 Model ICR18650-22F

3. Nominal Specifications

Item	Specification
3.1 Nominal Capacity	2200mAh (0.2C discharge)
3.2 Charging Voltage	4.2V
3.3 Nominal Voltage	3.6V
3.4 Charging Method	CC-CV (constant voltage with limited current)
3.5 Charging Current	Standard charge: 1100mA Rapid charge : 2200mA
3.6 Charging Time	Standard charge : 3hours Rapid charge : 2.5hours
3.7 Max. Charge Current	2200mA
3.8 Max. Discharge Current	4400mA
3.9 Discharge Cut-off Voltage	2.75V
3.10 Cell Weight	44.5g max
3.11 Cell Dimension	Diameter(max.) : Φ 18.4 mm Height : 65mm max
3.12 Operating Temperature	Charge : 0 to 45℃ Discharge: -20 to 60℃
3.13 Storage Temperature	1 year : -20~25℃(1*) 3 months : -20~45℃(1*) 1 month : -20~60℃(1*)

Note (1): If the cell is kept as ex-factory status(50% of charge), the capacity recovery rate is more than 80%.

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4. Outline Dimensions

See the attachment(Fig. 1)

5. Appearance

There shall be no such defects as scratch, rust, discoloration, leakage which may adversely affect commercial value of the cell.

6. Standard Test Conditions

6.1 Environmental Conditions

Unless otherwise specified, all tests stated in this specification are conducted at temperature 25±5℃ and humidity 65±20%.

6.2 Measuring Equipment

(1) Ammeter and Voltmeter

The ammeter and voltmeter should have an accuracy of the grade 0.5 or higher.

(2) Slide caliper

The slide caliper should have 0.05 mm scale.

(3) Impedance meter

The impedance meter with AC 1kHz should be used.

7. Characteristics

7.1 Standard Charge

This "Standard Charge" means charging the cell with charge current 1100mA and constant voltage 4.2V at 25℃ for 3hours.

7.2 Standard Discharge Capacity

The standard discharge capacity is the initial discharge capacity of the cell, which is measured with discharge current of 440mA with 2.75V cut-off at 25℃ within 1 hour after the Standard charge.

Standard Discharge Capacity ≥ 2150mAh

7.3 Initial internal impedance

Initial internal impedance measured at AC 1kHz after Standard charge.

Initial internal impedance ≤ 100mΩ

7.4 Temperature Dependence of Discharge Capacity

Discharge capacity comparison at each temperature, measured with discharge constant current 1100mA and 2.75V cut-off with follow temperature after the standard charging at 25℃.

Charge Temperature	Discharge temperature			
25℃	-10℃	0℃	25℃	45℃
Relative Capacity	50%	70%	100%	100%

Note: If charge temperature and discharge temperature is not the same,
the interval for temperature change is 3 hours.
Percentage as an index of the Standard discharge capacity(=2150mAh) is 100%.

7.5 Temperature Dependence of Charge Capacity

Capacity comparison at each temperature, measured with discharge constant current 1000mA and 2.75V cut-off at 25℃ after the Standard charge is as follow temperature.

	Charge temperature			Discharge temperature
	0℃	25℃	45℃	25℃
Relative Capacity	80%	100%	100%	

Note: If charge temperature and discharge temperature is not the same,
the interval for temperature change is 3 hours.
Percentage as an index of the Standard discharge capacity(=2150mAh) is 100%.

7.6 Cycle Life

Each cycle is an interval between the charge (charge current 1760mA) and the discharge (discharge current 2200mA) with 2.75V cut-off. Capacity after 299cycles and plus 1 day, measured under the same condition in 7.2

Capacity ≥ 1500mAh

7.7 Storage Characteristics

Capacity after storage for 30days at 25℃ after the Standard charged, measured with discharge current 1100mA with 2.75V cut-off at 25℃.

Capacity retention(after the storage) ≥ 1720mAh

7.8 Status of the cell as of ex-factory

The cell should be shipped in 50% charged state.

8. Mechanical Characteristics

8.1 Drop Test

Test method: Cell(as of shipment or full charged) drop onto the oak-board (thickness: ≥30mm) from 1.5m height at a random direction 6 times.

Criteria: No leakage

8.2 Vibration Test

Test method: Cell(as of shipment) is vibrated along 2 mutually perpendicular axes with total excursion of 1.6mm and with frequency cycling between 10Hz and 55Hz by 1Hz/min.

Criteria: No leakage

Lampiran 2. Data Sheet Arduino Pro Mini

1. Description

The Atmel AVR® core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in a single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

The ATmega328/P provides the following features: 32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 1Kbytes EEPROM, 2Kbytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), three flexible Timer/Counters with compare modes and PWM, 1 serial programmable USARTs , 1 byte-oriented 2-wire Serial Interface (I2C), a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages) , a programmable Watchdog Timer with internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption. In Extended Standby mode, both the main oscillator and the asynchronous timer continue to run.

Atmel offers the QTouch® library for embedding capacitive touch buttons, sliders and wheels functionality into AVR microcontrollers. The patented charge-transfer signal acquisition offers robust sensing and includes fully debounced reporting of touch keys and includes Adjacent Key Suppression® (AKS™) technology for unambiguous detection of key events. The easy-to-use QTouch Suite toolchain allows you to explore, develop and debug your own touch applications.

The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core. The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega328/P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications.

The ATmega328/P is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.

2. Configuration Summary

Features	ATmega328/P
Pin Count	28/32
Flash (Bytes)	32K
SRAM (Bytes)	2K
EEPROM (Bytes)	1K
General Purpose I/O Lines	23
SPI	2
TWI (I^2C)	1
USART	1
ADC	10-bit 15kSPS
ADC Channels	8
8-bit Timer/Counters	2
16-bit Timer/Counters	1

3. Ordering Information

3.1. ATmega328

Speed [MHz][3]	Power Supply [V]	Ordering Code[2]	Package[1]	Operational Range
20	1.8 - 5.5	ATmega328-AU ATmega328-AUR[5] ATmega328-MMH[4] ATmega328-MMHR[4][5] ATmega328-MU ATmega328-MUR[5] ATmega328-PU	32A 32A 28M1 28M1 32M1-A 32M1-A 28P3	Industrial (-40°C to 85°C)

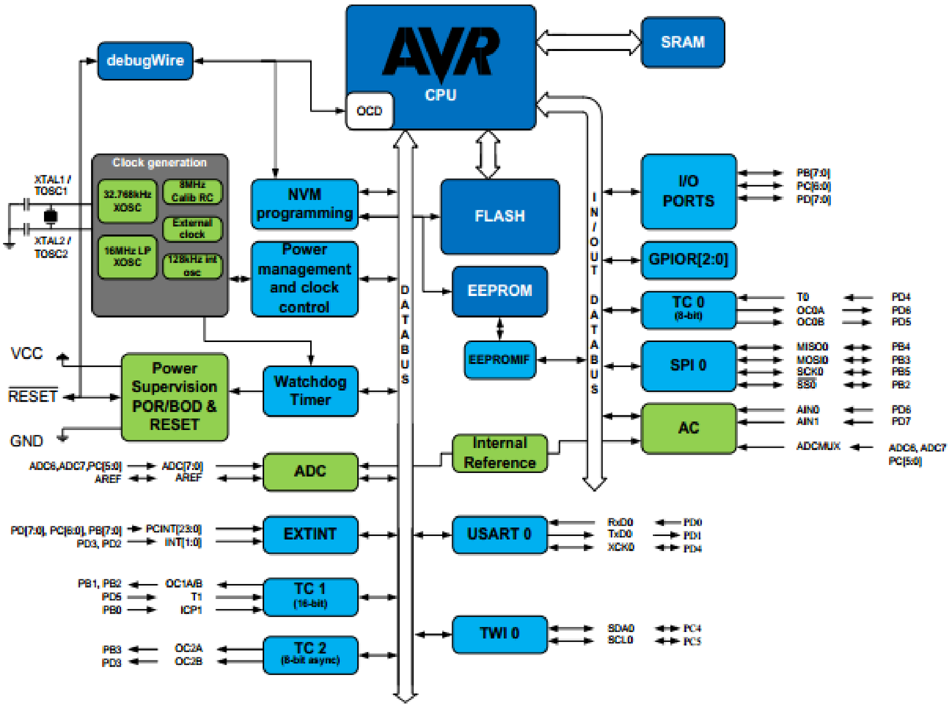
Note:

1. This device can also be supplied in wafer form. Please contact your local Atmel sales office for detailed ordering information and minimum quantities.
2. Pb-free packaging, complies to the European Directive for Restriction of Hazardous Substances (RoHS directive). Also Halide free and fully Green.
3. Please refer to *Speed Grades* for Speed vs. V_{CC}
4. Tape & Reel.
5. NiPdAu Lead Finish.

Package Type	
28M1	28-pad, 4 x 4 x 1.0 body, Lead Pitch 0.45mm Quad Flat No-Lead/Micro Lead Frame Package (QFN/ MLF)
28P3	28-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP)
32M1-A	32-pad, 5 x 5 x 1.0 body, Lead Pitch 0.50mm Quad Flat No-Lead/Micro Lead Frame Package (QFN/ MLF)
32A	32-lead, Thin (1.0mm) Plastic Quad Flat Package (TQFP)

4. Block Diagram

Figure 4-1. Block Diagram



Lampiran 3. Konverter DC Penaik Tegangan

XLSEMI® XL6009

400KHz 60V 4A Switching Current Boost / Buck-Boost / Inverting DC/DC Converter

Features

- Wide 5V to 32V Input Voltage Range
- Positive or Negative Output Voltage Programming with a Single Feedback Pin
- Current Mode Control Provides Excellent Transient Response
- 1.25V reference adjustable version
- Fixed 400KHz Switching Frequency
- Maximum 4A Switching Current
- SW PIN Built in Over Voltage Protection
- Excellent line and load regulation
- EN PIN TTL shutdown capability
- Internal Optimize Power MOSFET
- High efficiency up to 94%
- Built in Frequency Compensation
- Built in Soft-Start Function
- Built in Thermal Shutdown Function
- Built in Current Limit Function
- Available in TO263-5L package

Applications

- EPC / Notebook Car Adapter
- Automotive and Industrial Boost / Buck-Boost / Inverting Converters
- Portable Electronic Equipment

General Description

The XL6009 regulator is a wide input range, current mode, DC/DC converter which is capable of generating either positive or negative output voltages. It can be configured as either a boost, flyback, SEPIC or inverting converter. The XL6009 built in N-channel power MOSFET and fixed frequency oscillator, current-mode architecture results in stable operation over a wide range of supply and output voltages.

The XL6009 regulator is special design for portable electronic equipment applications.

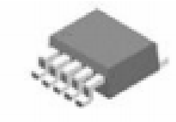


Figure1. Package Type of XL6009

400KHz 60V 4A Switching Current Boost / Buck-Boost / Inverting DC/DC Converter

Pin Configurations

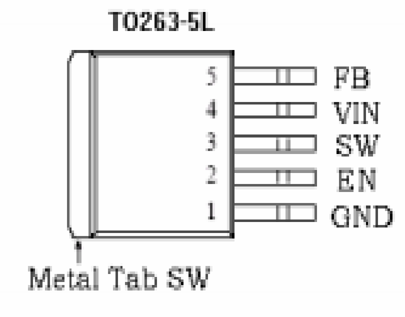


Figure2. Pin Configuration of XL6009 (Top View)

Table 1 Pin Description

Pin Number	Pin Name	Description
1	GND	Ground Pin.
2	EN	Enable Pin. Drive EN pin low to turn off the device, drive it high to turn it on. Floating is default high.
3	SW	Power Switch Output Pin (SW).
4	VIN	Supply Voltage Input Pin. XL6009 operates from a 5V to 32V DC voltage. Bypass Vin to GND with a suitably large capacitor to eliminate noise on the input.
5	FB	Feedback Pin (FB). Through an external resistor divider network, FB senses the output voltage and regulates it. The feedback threshold voltage is 1.25V.

Ordering Information

Package	Temperature Range	Part Number	Marking ID	Packing Type
		Lead Free	Lead Free	
		XL6009E1	XL6009E1	Tube
		XL6009TRE1	XL6009E1	Tape & Reel

XLSEMI Pb-free products, as designated with "E1" suffix in the par number, are RoHS compliant.

Absolute Maximum Ratings（Note1）

Parameter	Symbol	Value	Unit
Input Voltage	Vin	-0.3 to 36	V
Feedback Pin Voltage	V_{FB}	-0.3 to Vin	V
EN Pin Voltage	V_{EN}	-0.3 to Vin	V
Output Switch Pin Voltage	V_{Output}	-0.3 to 60	V
Power Dissipation	P_D	Internally limited	mW
Thermal Resistance (TO263-5L) (Junction to Ambient, No Heatsink, Free Air)	R_{JA}	30	°C/W
Operating Junction Temperature	T_J	-40 to 125	°C
Storage Temperature	T_{STG}	-65 to 150	°C
Lead Temperature (Soldering, 10 sec)	T_{LEAD}	260	°C
ESD (HBM)		>2000	V

Note1: Stresses greater than those listed under Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

XL6009 Electrical Characteristics

T_a = 25℃;unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
System parameters test circuit figure4						
VFB	Feedback Voltage	Vin = 12V to 16V, Vout=18V Iload=0.1A to 2A	1.213	1.25	1.287	V
Efficiency	η	Vin=12V ,Vout=18.5V Iout=2A	-	92	-	%

Electrical Characteristics (DC Parameters)

Vin = 12V, GND=0V, Vin & GND parallel connect a 220uf/50V capacitor; Iout=0.5A, T_a = 25℃; the others floating unless otherwise specified.

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input operation voltage	Vin		5		32	V
Shutdown Supply Current	I_{STBY}	V_{EN}=0V		70	100	uA
Quiescent Supply Current	I_q	V_{EN} =2V, V_{FB} =Vin		2.5	5	mA
Oscillator Frequency	Fosc		320	400	480	Khz
Switch Current Limit	I_L	V_{FB} =0		4		A
Output Power NMOS	Rdson	Vin=12V, I_{SW}=4A		110	120	mohm
EN Pin Threshold	V_{EN}	High (Regulator ON) Low (Regulator OFF)		1.4 0.8		V
EN Pin Input Leakage Current	I_H	V_{EN} =2V (ON)		3	10	uA
	I_L	V_{EN} =0V (OFF)		3	10	uA
Max. Duty Cycle	D_{MAX}	V_{FB}=0V		90		%

Lampiran 4. Konverter DC Penurun Tegangan

The Future of Analog IC Technology®

MP1584

3A, 1.5MHz, 28V Step-Down Converter

DESCRIPTION

The MP1584 is a high frequency step-down switching regulator with an integrated internal high-side high voltage power MOSFET. It provides 3A output with current mode control for fast loop response and easy compensation.

The wide 4.5V to 28V input range accommodates a variety of step-down applications, including those in an automotive input environment. A 100µA operational quiescent current allows use in battery-powered applications.

High power conversion efficiency over a wide load range is achieved by scaling down the switching frequency at light load condition to reduce the switching and gate driving losses.

The frequency foldback helps prevent inductor current runaway during startup and thermal shutdown provides reliable, fault tolerant operation.

By switching at 1.5MHz, the MP1584 is able to prevent EMI (Electromagnetic Interference) noise problems, such as those found in AM radio and ADSL applications.

The MP1584 is available in a thermally enhanced SOIC8E package.

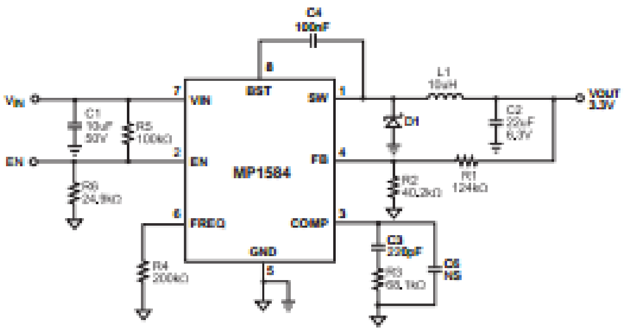
FEATURES

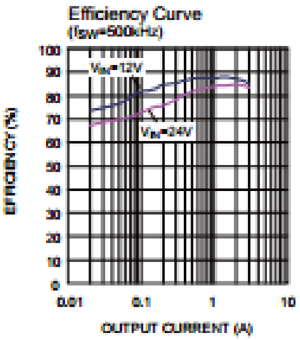
- Wide 4.5V to 28V Operating Input Range
- Programmable Switching Frequency from 100kHz to 1.5MHz
- High-Efficiency Pulse Skipping Mode for Light Load
- Ceramic Capacitor Stable
- Internal Soft-Start
- Internally Set Current Limit without a Current Sensing Resistor
- Available in SOIC8E Package.

APPLICATIONS

- High Voltage Power Conversion
- Automotive Systems
- Industrial Power Systems
- Distributed Power Systems
- Battery Powered Systems

TYPICAL APPLICATION





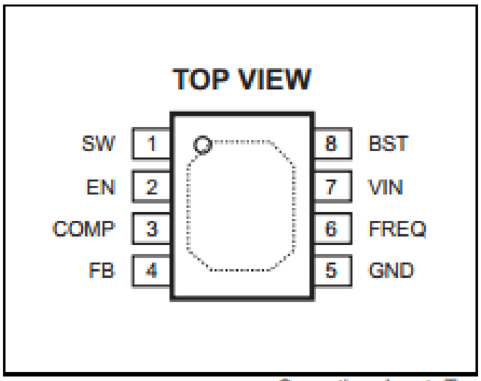
ORDERING INFORMATION

Part Number*	Package	Top Marking	Free Air Temperature (T_A)
MP1584EN	SOIC8E	MP1584EN	–20°C to +85°C

* For Tape & Reel, add suffix –Z (e.g. MP1584EN–Z);

For RoHS Compliant Packaging, add suffix –LF. (e.g. MP1584EN–LF–Z)

PACKAGE REFERENCE



ABSOLUTE MAXIMUM RATINGS [1]

Supply Voltage (V_{IN}).....................–0.3V to +30V
Switch Voltage (V_{SW})............–0.3V to V_{IN} + 0.3V
BST to SW..–0.3V to +6V
All Other Pins..................................–0.3V to +6V
Continuous Power Dissipation (T_A = +25°C)[2]
....2.5W
Junction Temperature................................150°C
Lead Temperature.....................................260°C
Storage Temperature.............. –65°C to +150°C

Recommended Operating Conditions [3]

Supply Voltage V_{IN}...........................4.5V to 28V
Output Voltage V_{OUT}.........................0.8V to 25V
Operating Junct. Temp (T_J) .....–20°C to +125°C

Thermal Resistance [4]	θ_{JA}	θ_{JC}	
SOIC8E	50	10...	°C/W

Notes:

1) Exceeding these ratings may damage the device.
2) The maximum allowable power dissipation is a function of the maximum junction temperature T_J(MAX), the junction-to-ambient thermal resistance θ_{JA}, and the ambient temperature T_A. The maximum allowable continuous power dissipation at any ambient temperature is calculated by $P_D(MAX)=(T_J(MAX)-T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.
3) The device is not guaranteed to function outside of its operating conditions.
4) Measured on JESD51-7, 4-layer PCB.

ELECTRICAL CHARACTERISTICS

V_{IN} = 12V, V_{EN} = 2.5V, V_{COMP} = 1.4V, T_A= +25°C, unless otherwise noted.

Parameter	Symbol	Condition	Min	Typ	Max	Units
Feedback Voltage	V_{FB}	4.5V < V_{IN} < 28V	0.776	0.8	0.824	V
Upper Switch On Resistance	$R_{DS(ON)}$	V_{BST} – V_{SW} = 5V		150		mΩ
Upper Switch Leakage		V_{EN} = 0V, V_{SW} = 0V, V_{IN} = 28V		1		μA
Current Limit			4.0	4.7		A
COMP to Current Sense Transconductance	G_{CS}			9		A/V
Error Amp Voltage Gain [5]				200		V/V
Error Amp Transconductance		I_{COMP} = ±3μA	40	60	80	μA/V
Error Amp Min Source current		V_{FB} = 0.7V		5		μA
Error Amp Min Sink current		V_{FB} = 0.9V		–5		μA
VIN UVLO Threshold			2.7	3.0	3.3	V
VIN UVLO Hysteresis				0.35		V
Soft-Start Time [5]		0V < V_{FB} < 0.8V		1.5		ms
Oscillator Frequency		R_{FREQ} = 100kΩ		900		kHz
Shutdown Supply Current		V_{EN} = 0V		12	20	μA
Quiescent Supply Current		No load, V_{FB} = 0.9V		100	125	μA
Thermal Shutdown				150		°C
Thermal Shutdown Hysteresis				15		°C
Minimum Off Time [5]				100		ns
Minimum On Time [5]				100		ns
EN Up Threshold			1.35	1.5	1.65	V
EN Hysteresis				300		mV

Note:

5) Guaranteed by design.

Lampiran 5. Mosfet IRLB3034

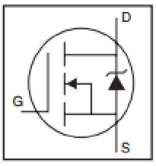
International
IOR Rectifier

PD -97363

IRLB3034PbF

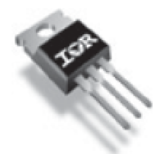
HEXFET® Power MOSFET

Applications
- DC Motor Drive
- High Efficiency Synchronous Rectification in SMPS
- Uninterruptible Power Supply
- High Speed Power Switching
- Hard Switched and High Frequency Circuits



V_{DSS}		40V
$R_{DS(on)}$	typ.	1.4mΩ
	max.	1.7mΩ
$I_{D\ (Silicon\ Limited)}$		343A①
$I_{D\ (Package\ Limited)}$		195A

Benefits
- Optimized for Logic Level Drive
- Very Low $R_{DS(ON)}$ at 4.5V V_{GS}
- Superior R*Q at 4.5V V_{GS}
- Improved Gate, Avalanche and Dynamic dV/dt Ruggedness
- Fully Characterized Capacitance and Avalanche SOA
- Enhanced body diode dV/dt and dI/dt Capability
- Lead-Free



TO-220AB
IRLB3034PbF

G	D	S
Gate	Drain	Source

Absolute Maximum Ratings

Symbol	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	343①	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	243 ①	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Package Limited)	195	
I_{DM}	Pulsed Drain Current ②	1372	
P_D @T_C = 25°C	Maximum Power Dissipation	375	W
	Linear Derating Factor	2.5	W/°C
V_{GS}	Gate-to-Source Voltage	±20	V
dv/dt	Peak Diode Recovery ④	4.6	V/ns
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds (1.6mm from case)	300	
	Mounting torque, 6-32 or M3 screw	10lbf·in (1.1N·m)	

Avalanche Characteristics

$E_{AS\ (Thermally\ limited)}$	Single Pulse Avalanche Energy ③	255	mJ
I_{AR}	Avalanche Current ②	See Fig. 14, 15, 22a, 22b,	A
E_{AR}	Repetitive Avalanche Energy ②		mJ

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑧	—	0.4	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.5	—	
$R_{\theta JA}$	Junction-to-Ambient	—	62	

IRLB3034PbF

International IOR Rectifier

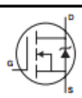
Static @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	—	—	V	V_{GS} = 0V, I_D = 250μA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.04	—	V/°C	Reference to 25°C, I_D = 5mA②
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	1.4	1.7	mΩ	V_{GS} = 10V, I_D = 195A ⑤
		—	1.6	2.0		V_{GS} = 4.5V, I_D = 172A ⑤
$V_{GS(th)}$	Gate Threshold Voltage	1.0	—	2.5	V	V_{DS} = V_{GS}, I_D = 250μA
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	V_{DS} = 40V, V_{GS} = 0V
		—	—	250		V_{DS} = 40V, V_{GS} = 0V, T_J = 125°C
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	V_{GS} = 20V
	Gate-to-Source Reverse Leakage	—	—	-100		V_{GS} = -20V
$R_{G(int)}$	Internal Gate Resistance	—	2.1	—	Ω	

Dynamic @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Transconductance	286	—	—	S	V_{DS} = 10V, I_D = 195A
Q_g	Total Gate Charge	—	108	162	nC	I_D = 185A
Q_{gs}	Gate-to-Source Charge	—	29	—		V_{DS} = 20V
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	54	—		V_{GS} = 4.5V ⑤
Q_{sync}	Total Gate Charge Sync. (Q_g - Q_{gd})	—	54	—		I_D = 185A, V_{DS} =0V, V_{GS} = 4.5V
$t_{d(on)}$	Turn-On Delay Time	—	65	—	ns	V_{DD} = 26V
t_r	Rise Time	—	827	—		I_D = 195A
$t_{d(off)}$	Turn-Off Delay Time	—	97	—		R_G = 2.1Ω
t_f	Fall Time	—	355	—		V_{GS} = 4.5V ⑤
C_{iss}	Input Capacitance	—	10315	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	1980	—		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	—	935	—		*f* = 1.0MHz
C_{oss} eff. (ER)	Effective Output Capacitance (Energy Related)⑦	—	2378	—		V_{GS} = 0V, V_{DS} = 0V to 32V ⑦
C_{oss} eff. (TR)	Effective Output Capacitance (Time Related) ⑥	—	2986	—		V_{GS} = 0V, V_{DS} = 0V to 32V ⑥

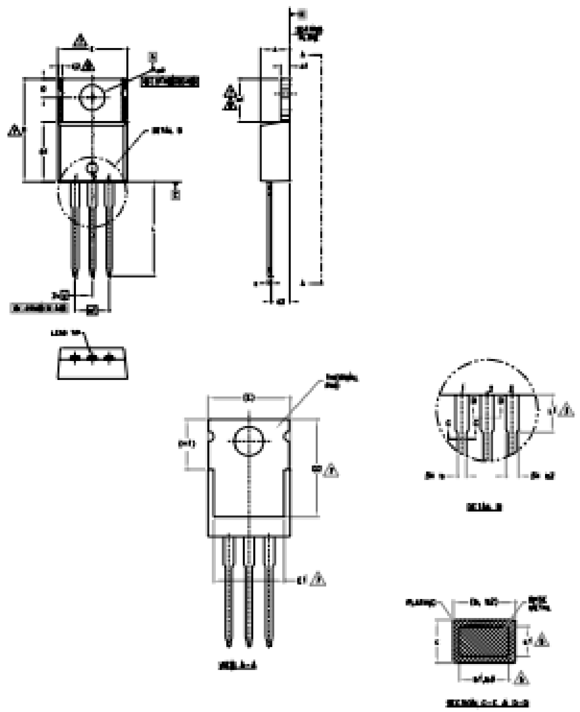
Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	343①	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ②	—	—	1372		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	T_J = 25°C, I_S = 195A, V_{GS} = 0V ⑤
t_{rr}	Reverse Recovery Time	—	39	—	ns	T_J = 25°C V_R = 34V,
		—	41	—		T_J = 125°C I_F = 195A
Q_{rr}	Reverse Recovery Charge	—	39	—	nC	T_J = 25°C di/dt = 100A/μs ⑤
		—	46	—		T_J = 125°C
I_{RRM}	Reverse Recovery Current	—	1.7	—	A	T_J = 25°C
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

IRLB3034PbF

TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

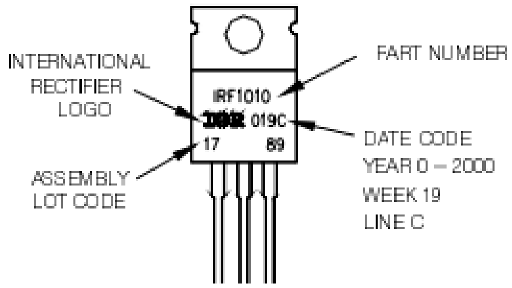
1.- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
2.- DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
3.- LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
4.- DIMENSION D, D1 & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5.- DIMENSION b1, b3 & c1 APPLY TO BASE METAL ONLY.
6.- CONTROLLING DIMENSION : INCHES.
7.- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
8.- DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.
9.- OUTLINE CONFORMS TO JEDEC TO-220, EXCEPT A2 (max.) AND D2 (min.) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.83	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.03	2.92	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.97	.015	.038	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	8.38	9.02	.330	.355	
D2	11.68	12.88	.460	.507	7
E	9.65	10.67	.380	.420	4,7
E1	6.86	8.89	.270	.350	7
E2	-	0.76	-	.030	8
e	2.54 BSC		.100 BSC		
e1	5.08 BSC		.200 BSC		
H1	5.84	6.86	.230	.270	7,8
L	12.70	14.73	.500	.580	
L1	3.56	4.06	.140	.160	3
ØP	3.54	4.08	.139	.161	
Q	2.54	3.42	.100	.135	

TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 2000
IN THE ASSEMBLY LINE "C"

Note: "P" in assembly line position indicates "Lead - Free"



Lampiran 6. BMS 4 Sel

Overview:

Main IC uses the original "Ricoh" imported components. Overcharge, over discharge, over current, short circuit protection, for a variety of capacities in various shapes 3.7V lithium batteries. Japan Seiko protection IC, VISHAY, AOS, IR and other high-quality MOSFET, FR-4 plate low temperature coefficient, design, fine workmanship, testing and comprehensive. Compact, suitable for many of the requirements of highly integrated, low-cost applications to meet a wide range of performance requirements to ensure the absolute safety and reliability of the battery pack.

The protection board device description:
Components for Japan's Seiko S-8254AAG protection chip; Genuine Bandai America's AO4407 * 2pcs; protect the chip as well as Ricoh R5431 series.

Lithium battery protection board attributes:
Model: HH-P3-10.8
Dimensions: 48 * 15 * 1.0mm
Charging voltage range: 4.25-4.35v ± 0.05v
Over-discharge voltage range: 2.3-3.0v ± 0.05v
Working temperature: -40 --- + 50 °C
Storage conditions: -40-- + 80 °C
Maximum operating current: 4-5A
The maximum instantaneous current: 6-7A
Quiescent Current: less than 6uA
Resistance: less than 45mΩ
Effective life: more than 50,000 hours
Short circuit protection: protect, need to be recharged recovery
Suitable for: 4packs 18650 lithium battery 14.8V 16.8V

The protective plate using Japan's Ricoh rechargeable lithium iron phosphate battery protection IC;

1) high-accuracy voltage detection circuit;

2) terminal of the charger using high voltage devices;

3) Built-in three-stage overcurrent detection circuit (overcurrent 1, overcurrent 2, load short circuit);

4) MOS transistor can be controlled by a battery charge and discharge;

5) low standby current consumption.

Function and Notice:

1, the lithium battery with protection board according to the wiring diagram connection, when the battery voltage is overcharge and over-discharge voltage between the voltage, and P +, P- charging 1 second, P + and P- output voltage of the battery voltage.

2, the battery charge function: between P + and P- plus charger to charge the battery, the battery voltage charge to overcharge detection voltage (4.25 ± 0.025V), the protection circuit to cut off the charging path, to achieve overcharge protection.

3, Battery over-discharge protection: in between the P + and P- connected load to the battery discharge when the battery voltage drops to over-discharge voltage (2.7 ± 0.05V), the protection circuit, shut off the discharge path to achieve the over-discharge protection.

4, Short circuit protection: When the P + and P- short circuit protection circuit will act quickly in 5-50uS, cut off access, short-circuit protection.

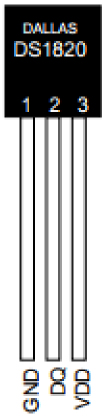
5, Overcurrent protection function: When the V- terminal voltage of (0.15 ± 0.02V), the protection circuit will act quickly in 6.7-13.9ms, cut off access, overcurrent protection.

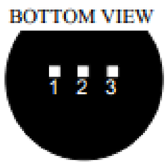
Lampiran 7. Sensor Suhu DS18B20

FEATURES

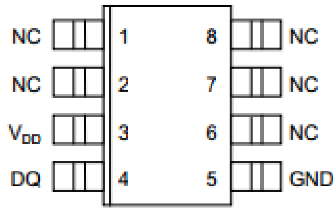
- Unique 1-Wire interface requires only one port pin for communication
- Multidrop capability simplifies distributed temperature sensing applications
- Requires no external components
- Can be powered from data line. Power supply range is 3.0V to 5.5V
- Zero standby power required
- Measures temperatures from -55°C to +125°C. Fahrenheit equivalent is -67°F to +257°F
- ±0.5°C accuracy from -10°C to +85°C
- Thermometer resolution is programmable from 9 to 12 bits
- Converts 12-bit temperature to digital word in 750 ms (max.)
- User-definable, nonvolatile temperature alarm settings
- Alarm search command identifies and addresses devices whose temperature is outside of programmed limits (temperature alarm condition)
- Applications include thermostatic controls, industrial systems, consumer products, thermometers, or any thermally sensitive system

PIN ASSIGNMENT





DS18B20 To-92 Package



DS18B20Z
8-Pin SOIC (150 mil)

PIN DESCRIPTION

GND - Ground
DQ - Data In/Out
V_{DD} - Power Supply Voltage
NC - No Connect

DESCRIPTION

The DS18B20 Digital Thermometer provides 9 to 12-bit (configurable) temperature readings which indicate the temperature of the device.

Information is sent to/from the DS18B20 over a 1-Wire interface, so that only one wire (and ground) needs to be connected from a central microprocessor to a DS18B20. Power for reading, writing, and performing temperature conversions can be derived from the data line itself with no need for an external power source.

Because each DS18B20 contains a unique silicon serial number, multiple DS18B20s can exist on the same 1-Wire bus. This allows for placing temperature sensors in many different places. Applications where this feature is useful include HVAC environmental controls, sensing temperatures inside buildings, equipment or machinery, and process monitoring and control.

DETAILED PIN DESCRIPTION Table 1

PIN 8PIN SOIC	PIN TO92	SYMBOL	DESCRIPTION
5	1	GND	Ground.
4	2	DQ	**Data Input/Output pin.** For 1-Wire operation: Open drain. (See "Parasite Power" section.)
3	3	V_{DD}	**Optional V_{DD} pin.** See "Parasite Power" section for details of connection. V_{DD} must be grounded for operation in parasite power mode.

DS18B20Z (8-pin SOIC): All pins not specified in this table are not to be connected.

OVERVIEW

The block diagram of Figure 1 shows the major components of the DS18B20. The DS18B20 has four main data components: 1) 64-bit lasered ROM, 2) temperature sensor, 3) nonvolatile temperature alarm triggers TH and TL, and 4) a configuration register. The device derives its power from the 1-Wire communication line by storing energy on an internal capacitor during periods of time when the signal line is high and continues to operate off this power source during the low times of the 1-Wire line until it returns high to replenish the parasite (capacitor) supply. As an alternative, the DS18B20 may also be powered from an external 3 volt - 5.5 volt supply.

Communication to the DS18B20 is via a 1-Wire port. With the 1-Wire port, the memory and control functions will not be available before the ROM function protocol has been established. The master must first provide one of five ROM function commands: 1) Read ROM, 2) Match ROM, 3) Search ROM, 4) Skip ROM, or 5) Alarm Search. These commands operate on the 64-bit lasered ROM portion of each device and can single out a specific device if many are present on the 1-Wire line as well as indicate to the bus master how many and what types of devices are present. After a ROM function sequence has been successfully executed, the memory and control functions are accessible and the master may then provide any one of the six memory and control function commands.

One control function command instructs the DS18B20 to perform a temperature measurement. The result of this measurement will be placed in the DS18B20's scratch-pad memory, and may be read by issuing a memory function command which reads the contents of the scratchpad memory. The temperature alarm triggers TH and TL consist of 1 byte EEPROM each. If the alarm search command is not applied to the DS18B20, these registers may be used as general purpose user memory. The scratchpad also contains a configuration byte to set the desired resolution of the temperature to digital conversion. Writing TH, TL, and the configuration byte is done using a memory function command. Read access to these registers is through the scratchpad. All data is read and written least significant bit first.

Lampiran 8. Program Keseluruhan

```
#include <OneWire.h>
#include <DallasTemperature.h>
#define ONE_WIRE_BUS 4
#define TEMPERATURE_PRECISION 9

OneWire oneWire(ONE_WIRE_BUS);
DallasTemperature sensors(&oneWire);
DeviceAddress sensor1,sensor2;

int vbat;
int fan_on=0;
int output_pid;
int sp=32;
float suhu_aktual;
float rate=0;
float error=0;
float last_error=0;
int kp=20;
int kd=1;
int ki=3;
float suhu1;
float suhu2;
float tempC;

void setup()
{
  TCCR2B = TCCR2B & 0b11111000 |0x07; // mengubah frekuensi pwm
  Serial.begin(9600);
  pinMode(12, OUTPUT);
  pinMode(11, OUTPUT);
```

```
  pinMode(10, OUTPUT);
  pinMode(A2, OUTPUT);
  pinMode(A3, OUTPUT);
  pinMode(6,  OUTPUT);
  pinMode(7,  OUTPUT);

  pinMode(A1,INPUT_PULLUP);
  pinMode(A0,INPUT);
  pinMode(4,INPUT);
  pinMode(5,INPUT);

  Serial.begin(9600);
  Serial.println("Dallas Temperature IC Control Library Demo");

  sensors.begin();
  Serial.print("Locating devices...");
  Serial.print("Found ");
  Serial.print(sensors.getDeviceCount(), DEC);
  Serial.println(" devices.");

  Serial.print("Parasite power is: ");
  if (sensors.isParasitePowerMode()) Serial.println("ON");
  else Serial.println("OFF");



  if (!sensors.getAddress(sensor1, 0)) Serial.println("Unable to find address for Device 0");
  if (!sensors.getAddress(sensor2, 1)) Serial.println("Unable to find address for Device 1");
```

```
  Serial.print("Device 0 Address: ");
  printAddress(sensor1);
  Serial.println();

  Serial.print("Device 1 Address: ");
  printAddress(sensor2);
  Serial.println();

  sensors.setResolution(sensor1, TEMPERATURE_PRECISION);
  sensors.setResolution(sensor2, TEMPERATURE_PRECISION);

  Serial.print("Device 0 Resolution: ");
  Serial.print(sensors.getResolution(sensor1), DEC);
  Serial.println();

  Serial.print("Device 1 Resolution: ");
  Serial.print(sensors.getResolution(sensor2), DEC);
  Serial.println();
}



void printAddress(DeviceAddress deviceAddress)
{
  for (uint8_t i = 0; i < 8; i++)
  {
    if (deviceAddress[i] < 16) Serial.print("0");
    Serial.print(deviceAddress[i], HEX);
  }
}
```

```
void printTemperature(DeviceAddress deviceAddress)
{
  tempC = sensors.getTempC(deviceAddress);
  Serial.print("Temp C: ");
  Serial.print(tempC);
  Serial.print(" Temp F: ");
  Serial.print(DallasTemperature::toFahrenheit(tempC));
}


void printResolution(DeviceAddress deviceAddress)
{
  Serial.print("Resolution: ");
  Serial.print(sensors.getResolution(deviceAddress));
  Serial.println();
}


void printData(DeviceAddress deviceAddress)
{
  Serial.print("Device Address: ");
  printAddress(deviceAddress);
  Serial.print(" ");
  printTemperature(deviceAddress);
  Serial.println();
}

void loop()
{
```

```
vbat=analogRead(A0);
if (vbat<=599)
{
digitalWrite(13,0);
digitalWrite(12,1);
digitalWrite(11,1);
digitalWrite(10,1);
digitalWrite(A3,1);
digitalWrite(A2,1);
}

else if (vbat>599 && vbat<=640)
{
digitalWrite(13,0);
digitalWrite(12,0);delay(100);
digitalWrite(11,1);
digitalWrite(10,1);
digitalWrite(A3,1);
digitalWrite(A2,1);
}

else if (vbat>640 && vbat<=680)
{
digitalWrite(13,0);
digitalWrite(12,0);delay(100);
digitalWrite(11,0);delay(100);
digitalWrite(10,1);
digitalWrite(A3,1);
digitalWrite(A2,1);
}
```

```
else if (vbat>680 && vbat<=721)
{
digitalWrite(13,0);
digitalWrite(12,0);delay(100);
digitalWrite(11,0);delay(100);
digitalWrite(10,0);delay(100);
digitalWrite(A3,1);
digitalWrite(A2,1);
}

else if(vbat>721 && vbat<=761)
{
digitalWrite(13,0);
digitalWrite(12,0);delay(100);
digitalWrite(11,0);delay(100);
digitalWrite(10,0);delay(100);
digitalWrite(A3,0);delay(100);
digitalWrite(A2,1);
}

else
{
digitalWrite(13,0);
digitalWrite(12,0);delay(100);
digitalWrite(11,0);delay(100);
digitalWrite(10,0);delay(100);
digitalWrite(A3,0);delay(100);
digitalWrite(A2,0);delay(100);
}

if (digitalRead(5)==1)
```

```
 {
 if(vbat<822){
 delay(500);
 digitalWrite(A2,1);
 digitalWrite(A3,1);
 digitalWrite(10,1);
 digitalWrite(11,1);
 digitalWrite(12,1);// dari level rendah ke tinggi
 digitalWrite(13,1);
 delay(500);
 }}

if (digitalRead(A1)==0){
 if(fan_on==1)fan_on=0;
 else fan_on=1;
}
 //delay(500);
 Serial.println(fan_on);


 if (fan_on==1)
 {digitalWrite (6,1);
 run_fan();}

 else
 {digitalWrite(6,0);
 digitalWrite(3,0);}

}
```

```
void run_fan ()
{
  sensors.requestTemperatures();
  printData(sensor1);
  suhu1=tempC;
  //Serial.print("suhu1=    ");
  //Serial.println(suhu1);

  printData(sensor2);
  suhu2=tempC;
  //Serial.print("suhu2=    ");
  //Serial.println(suhu2);

  if(suhu1>suhu2)suhu_aktual=suhu1;
  else suhu_aktual=suhu2;
  Serial.print("suhu_aktual=    ");
  Serial.println(suhu_aktual);

  error=suhu_aktual-sp;
  rate=last_error-error;

  output_pid = int(kp*error);
  last_error=error;

  if (output_pid>0)output_pid=output_pid+90;
  else output_pid=0;
  if (output_pid>255)output_pid=255;
  analogWrite(3,output_pid);
  Serial.print("Nilai PWM=    ");
  Serial.println(output_pid);
}
```