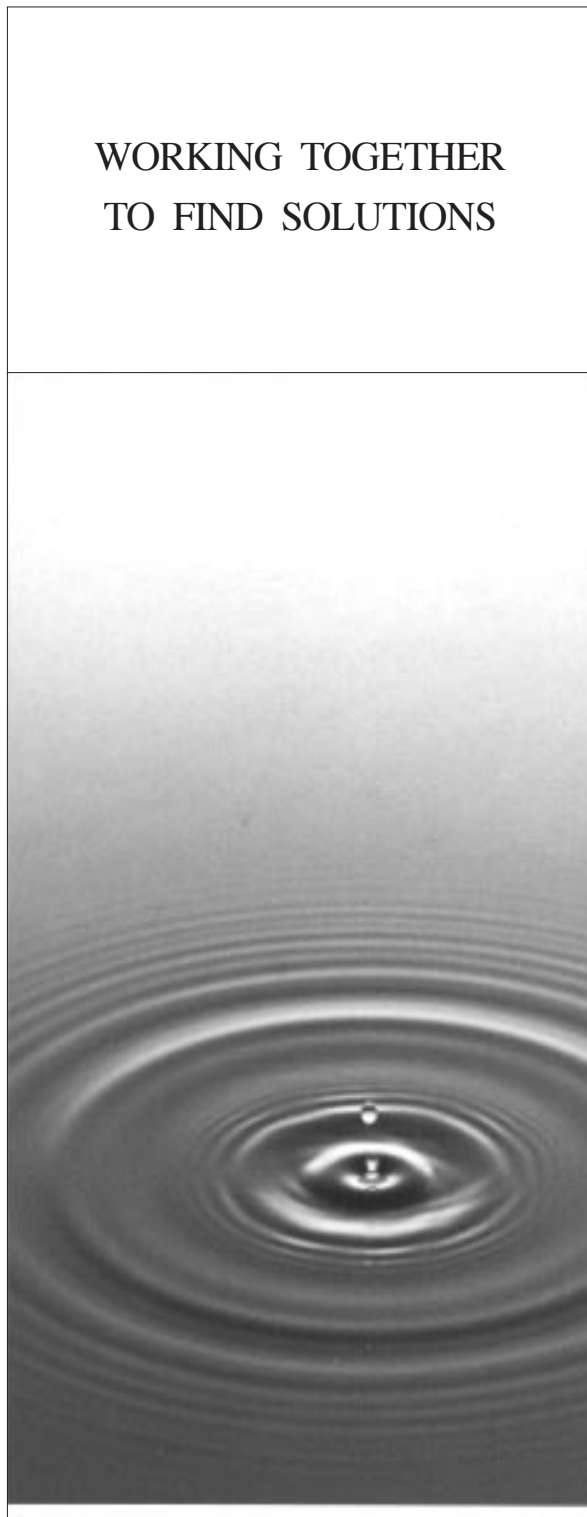


**RICOH**

## **POWER MANAGEMENT ICs**

WORKING TOGETHER  
TO FIND SOLUTIONS



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# Power Supply Systems To Meet Your Exact Needs

Today's consumer electronics products are becoming progressively smaller. They are also becoming more ecology-conscious and consequently more energy-efficient and environment-friendly. Power sources, likewise, are becoming more compact while operating at lower voltages and consuming less power.

Ricoh offers a wide range of low power consumption, high efficiency, compact CMOS ICs to meet these new needs of our customers. Our impressive IC product line-up includes everything from Voltage Detector, Voltage Regulator, and Step-up DC/DC Converter ICs, all the way up to Multi-Power Supply ICs with multiple functions integrated into a single chip especially suitable for special system applications. Ricoh's original laser trimming technology also makes possible high accuracy, precision voltage settings.

Ricoh's Power Management ICs ----- allowing you to configure power systems specifically suited to your exact needs.

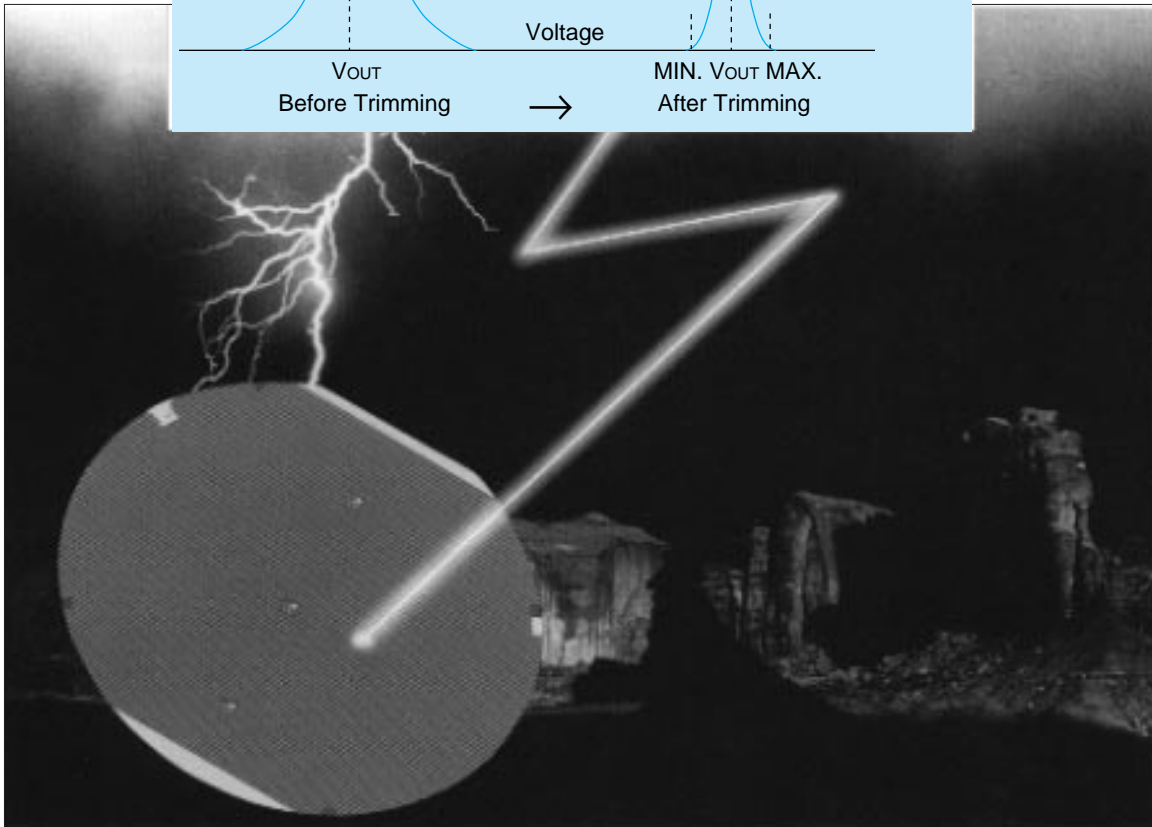
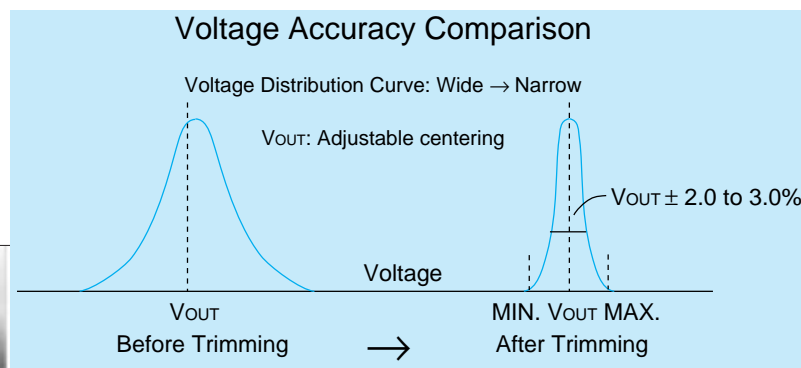
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# Ricoh Power Management IC Series

## Developing Products With A Difference Through Our Unique Laser Trimming Technology

The Ricoh Power Management IC Series, incorporating Ricoh's exclusive laser trimming technology, has achieved a voltage accuracy of  $\pm 2.0$  to  $3.0$  %. Coupled with amazing stepwise setting steps of  $0.1V$ , Ricoh Power Management ICs can meet your precisest needs with the utmost satisfaction.

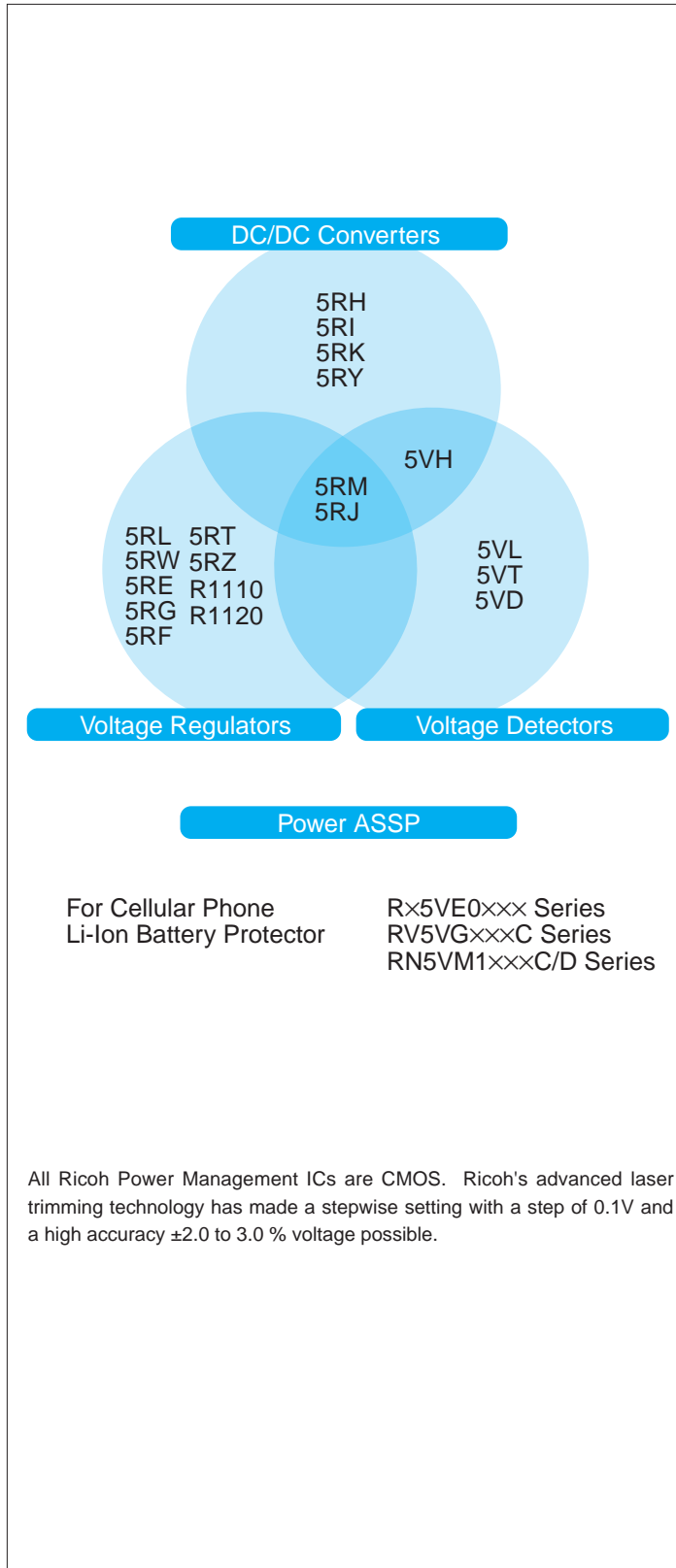


# 1 Product Line Overview

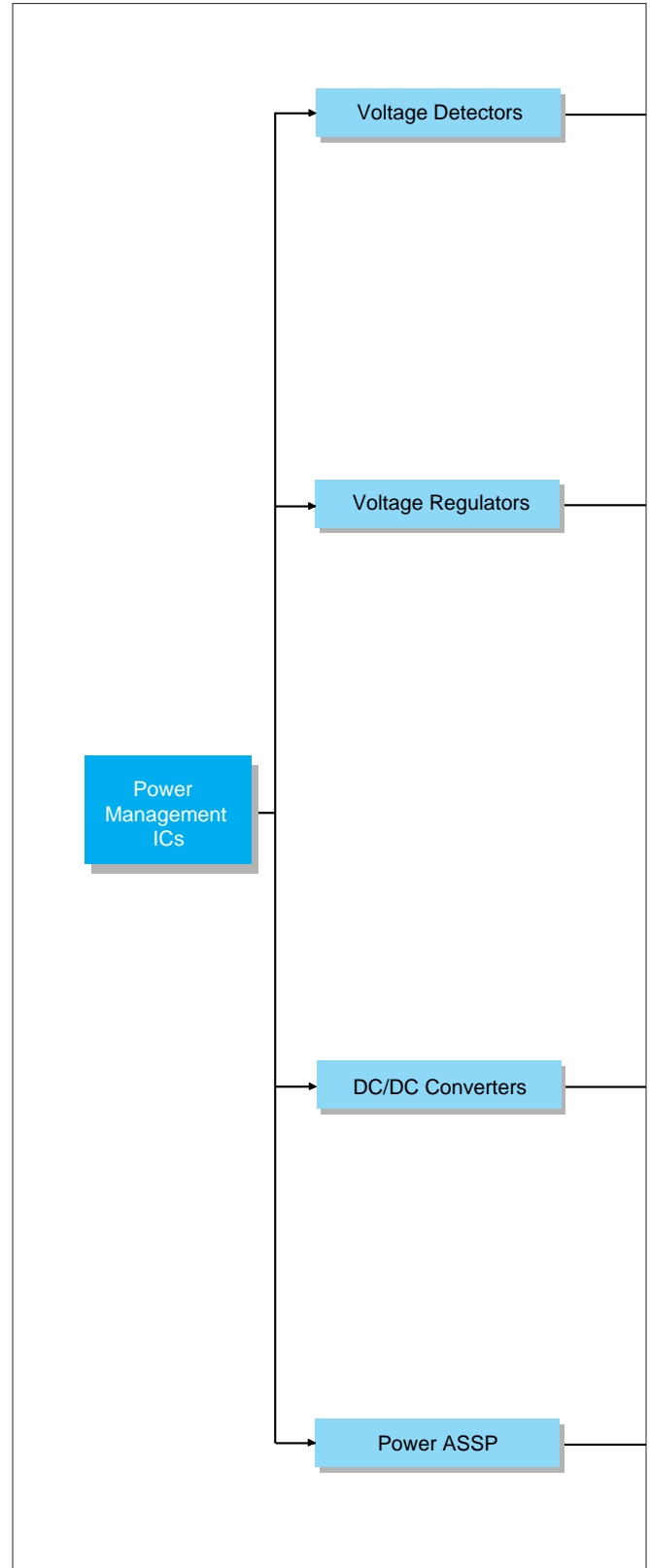
## Power Management ICs

A small, reliable power management IC is now a prerequisite for every one of today's compact, battery-powered electronic devices. Ricoh has developed an impressive line-up of multi-purpose CMOS Power Management ICs offering low supply current, high accuracy, high performance, and exceptionally small packages.

### Product Line-up



### Power Management IC Series Descriptions



	Rx5VL Series	High accuracy monitoring of battery and switching P.S.U. voltages. Best suited for micro-computers and memory resetting. Output can be selected from Nch. open drain and CMOS. Available in TO-92, SOT-89 and SOT-23-5 packages.
	Rx5VT Series	Voltage detectors for lower voltage than that of the Rx5VL series. Output can be selected from Nch. open drain and CMOS. Available in TO-92, SOT-89 and SOT-23-5 packages.
	RN5VD Series	Voltage detectors for lower voltage than of the Rx5VL series with output delay pin. Output can be selected from Nch. open drain and CMOS. Available in SOT-23-5 package.
	Rx5RL Series	High accuracy voltage regulators. Best suited for small portable devices. Minimal dropout voltage and low quiescent current result in extended battery life. Available in TO-92, SOT-89 and SOT-23-5 packages.
	RQ5RW Series	Voltage regulators with a chip enable function. So that the supply current on standby can be minimized. Since the package for these ICs are SC-82AB(Super Mini-mold)package, high density mounting of the ICs on boards is possible.
	Rx5RE Series	Regulators for larger output current and smaller dropout voltage than that of the Rx5RL series. Available in TO-92 and SOT-89 packages.
	RN5RG Series	Voltage regulators with external power transistor for even larger output current and smaller dropout voltage than that of the Rx5RE series. Available in SOT-23-5 package.
	RN5RF Series	Voltage regulators with external power transistor for even high ripple rejection than that of the RN5RG series. Available in SOT-23-5 package.
	RN5RT Series	Voltage regulators for smaller dropout voltage than that of the Rx5RE series. With a chip enable function result in extended battery life. Available in SOT-23-5 package.
	RN5RZ Series	Voltage regulators for large current and smaller dropout voltage than that of the RN5RT series and ultra-low supply current and superior ripple rejection. Available in SOT-23-5 package.
	R1110N Series	Voltage regulators with low ON resistance and high ripple rejection. Each model consists of a voltage reference unit, an error amplifier, resistors, a current limit circuit and a chip enable circuit. These ICs perform with low dropout voltage and a chip enable function. Available in SOT-23-5 package. Pinout is similar to the LP2980.
	R1120N Series	Voltage regulators with low ON resistance and high ripple rejection. Each model consists of a voltage reference unit, an error amplifier, resistors, a current limit circuit and a chip enable circuit. These ICs perform with low dropout voltage and a chip enable function. Available in SOT-23-5 package. Pinout is similar to the TK112.
	RH5RH Series	PWM control Step-up DC/DC converter ICs. Low supply current and low noise features make this your best choice for portable audio equipment. Comes in three models: Normal, Boost and Stand-by types. Available in SOT-89 and SOT-89-5 packages.
	RH5RI Series	VFM control Step-up DC/DC converter ICs. Even lower supply current than the RH5RH. Most suitable for portable devices requiring particularly low supply current. Comes in three models: Normal, Boost, and Stand-by types. Available in SOT-89 and SOT-89-5 packages.
	RN5RK Series	VFM Step-up DC/DC converter ICs. Most suitable for portable devices requiring particularly low supply current. Comes in two models: Normal (xx1), Boost(xx2). Available in SOT-23-5 package.
	RN5RYxx1A Series	VFM Step-up DC/DC converter Controller ICs with external power transistor. Removing internal drive transistor, RN5RYxx1A are housed in smaller package than that of RH5RIxx2B/xx3B. Available in SOT-23-5 package.
	RN5RY202A	VFM Step-up DC/DC converter Controller ICs with external power transistor for featuring adjustable output voltage (e.g. 30V) with external resistors. Available in SOT-23-5 package.
	RV5VH Series	Dual output DC/DC converter ICs integrating Step-up and inverting DC/DC converters and voltage detector are suitable for two supply systems such as pager, PDA, which need power supplies for LCD. Comes in three models: Normal (1xx), Boost (2xx), Boost and Voltage Adjustable (3xx).
	RS5RM Series	Step-up/step-down DC/DC converter ICs equipped with voltage detector. Keeps output voltage constant as PWM control DC/DC converter and series regulator in step-up mode, and as series regulator in step-down mode. Available in 8pin SOP package(1.27mm pitch).
	RS5RJ Series	Step-up/step-down DC/DC converter ICs equipped with voltage detector. Keeps output voltage constant as VFM control DC/DC converter and series regulator in step-up mode, and as series regulator in step-down mode. Available in 8pin SOP package(1.27mm pitch).
	Rx5VE0xxx Series	Four different types of voltage regulators and two types of voltage detectors in one. Mask options enable you to create the ideal power system for your products. Available in 16pin SOP package. (0.8mm pitch) and SSOP package (0.65mm pitch).
	RV5VGxxxC Series	Rechargeable Lithium-ion battery protectors. Built-in two or four voltage detectors protect over-charge, over-discharge and shorting circuit. Comes in two models; RV5VG1xxxC(for 1 cell) and RV5VG2xxxC(for 2 cell. underdevelopment). Available in 8pin SSOP package(0.65mm pitch).
	RN5VM1xxC/D Series	Protection ICs for Lithium-ion (Li+) batteries. The RN5VM Series can detect over-charge/discharge of Li+ one-cell and excess load current, further include a short circuit protector. Comes in two models : drawing load current is allowable (xxC)/not allowable (xxD) after detecting over-charge. Available in SOT-23-6 package.

## CMOS Voltage Detectors

### R×5VL Series

### Voltage Detector

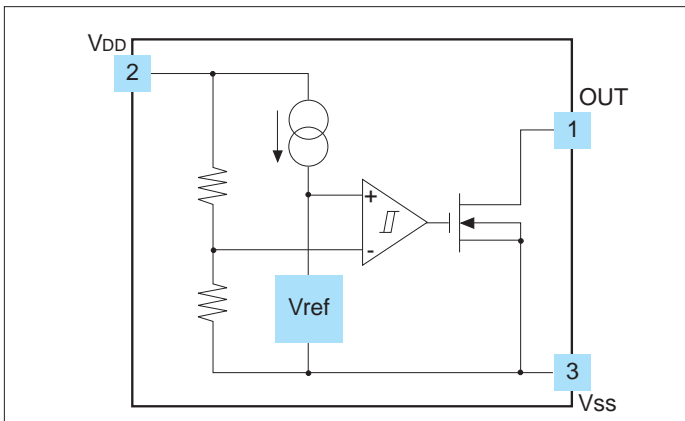
The R×5VL series are CMOS voltage detector ICs with high accuracy detector threshold and ultra-low supply current. Each model consists of a voltage reference unit, a comparator, resistors for voltage detection, a hysteresis circuit, and an output driver.

#### Features

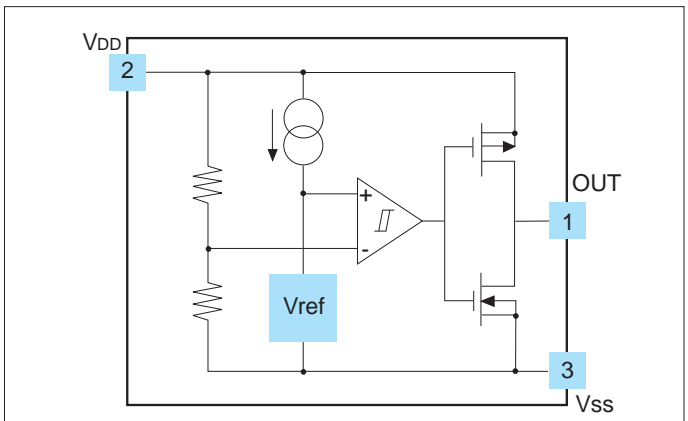
- ultra-low supply current .....TYP. 1.0μA ( $V_{DD} = 3.0V$ )
- broad operating voltage range .....1.5V to 10.0V
- high accuracy detector threshold .....±2.5%
- stepwise setting with a step of 0.1V in the range of 2.0V to 6.0V of detector threshold is possible
- low temperature drift coefficient of detector threshold ...TYP. ±100ppm/°C
- choice of output types .....Nch. open drain or CMOS
- three types of packages .....RE5VL .....TO-92  
RH5VL .....SOT-89  
RN5VL .....SOT-23-5

#### Block Diagrams

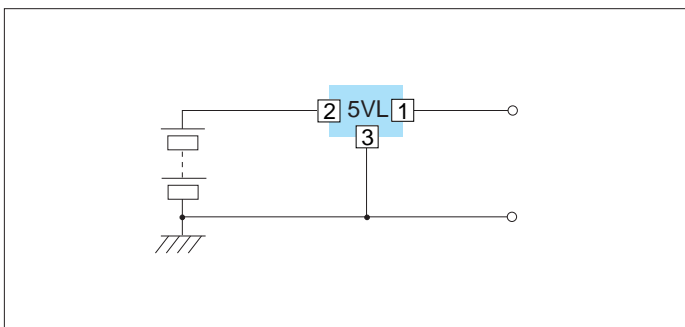
• Nch. Open Drain Output



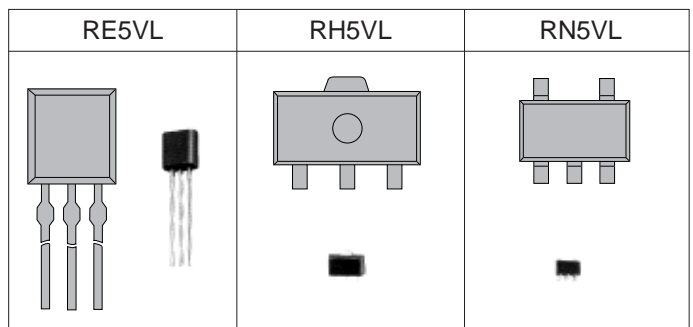
• CMOS Output



#### Typical Circuit Configuration



#### Packages



#### Applications

- CPU & logic circuit resetting
- battery checkers
- window comparators
- wave shaping circuits
- battery back-up circuits
- power failure detectors

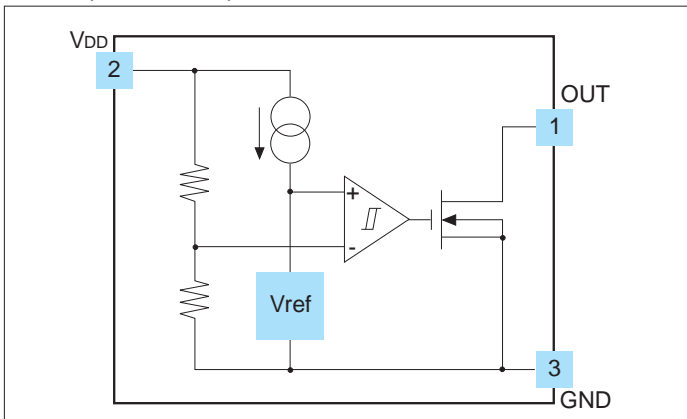
The R×5VT series are CMOS voltage detector ICs with high accuracy detector threshold and ultra-low supply current which allow low voltage operations. Each model consists of a voltage reference unit, a comparator, resistors for voltage detection, a hysteresis circuit and an output driver.

### Features

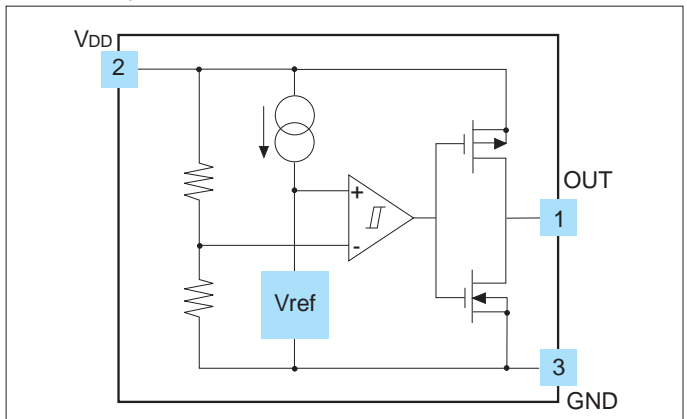
- ultra-low supply current .....TYP. 0.8μA (V<sub>DD</sub>=1.5V)
- broad operating voltage range .....0.7V to 10.0V (T<sub>opt</sub>=25°C)
- high accuracy detector threshold.....±2.5%
- stepwise setting with a step of 0.1V in the range of 0.9V to 6.0V of detector threshold is possible
- low temperature drift coefficient of detector threshold .....TYP. ±100ppm/°C
- choice of output types .....Nch. open drain or CMOS
- three types of packages .....RE5VT .....TO-92  
RH5VT .....SOT-89  
RN5VT .....SOT-23-5

### Block Diagrams

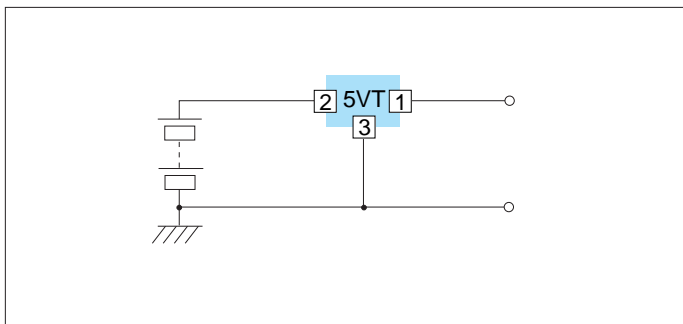
• Nch. Open Drain Output



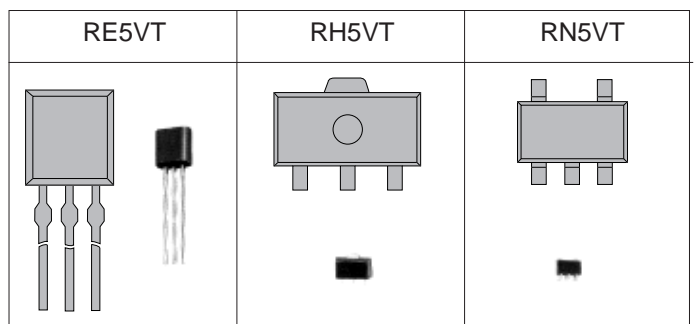
• CMOS Output



### Typical Circuit Configuration



### Packages



### Applications

- CPU & logic circuit resetting
- battery checkers
- window comparators
- wave shaping circuits
- battery back-up circuits
- power failure detectors

# RN5VD Series

## Voltage Detector with output delay

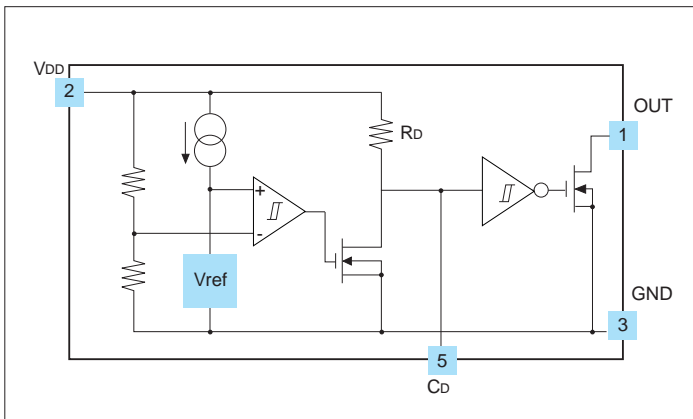
The RN5VD series are CMOS voltage detector ICs with high accuracy detector threshold, ultra-low supply current and output delay functions which allow low voltage operations. Each model consists of a voltage reference unit, a comparator, resistors for voltage detection, a hysteresis circuit, delay functions unit and an output driver.

### Features

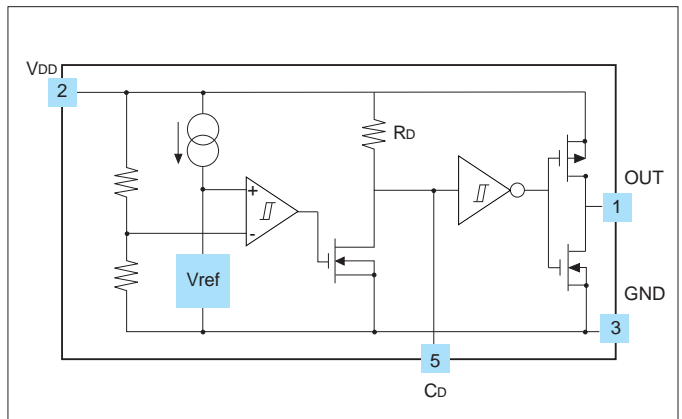
- output delay .....TYP. 100ms with external capacitor : 0.15μF
- ultra-low supply current .....TYP. 1.0μA (RN5VD15X : V<sub>DD</sub>=3.5V)
- broad operating voltage range .....0.7V to 10.0V (T<sub>opt</sub>=25°C)
- stepwise setting with a step of 0.1V in the range of 0.9V to 6.0V of detector threshold is possible
- high accuracy detector threshold .....±2.5%
- low temperature drift coefficient of detector threshold ...TYP. ±100ppm/°C
- choice of output types .....Nch. open drain or CMOS
- small package .....SOT-23-5

### Block Diagrams

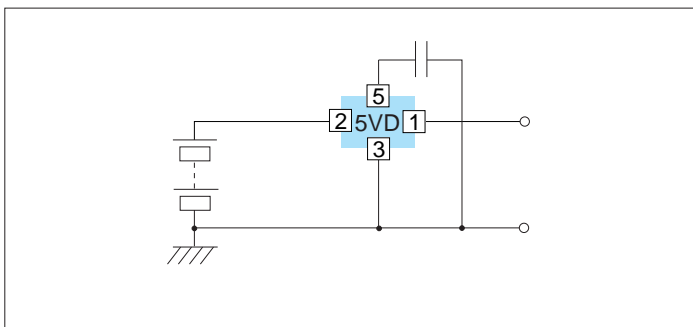
- Nch. Open Drain Output



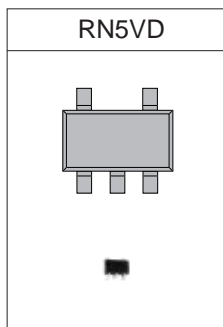
- CMOS Output



### Typical Circuit Configuration



### Package



### Applications

- CPU & logic circuit resetting
- battery checkers
- level discriminator
- switching circuit for battery back-up

# CMOS Voltage Regulators

## R×5RL Series

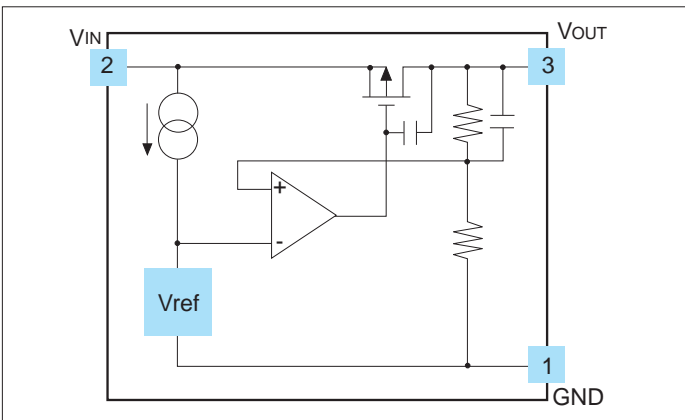
## Voltage Regulator

The R×5RL series are CMOS voltage regulator ICs with high accuracy output voltage and ultra low quiescent current. Each model consists of a voltage reference unit, an error amplifier, a driver transistor, and resistors for setting output voltage.

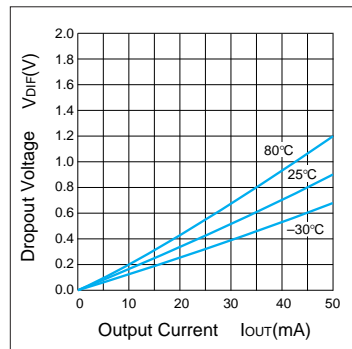
### Features

- ultra-low quiescent current .....TYP. 1.1μA (R×5RL30A,  $V_{IN}=5.0V$ )
- small dropout voltage .....TYP. 30mV (R×5RL50A,  $I_{OUT} = 1mA$ )
- stepwise setting with a step of 0.1V in the range of 2.0V to 6.0V of output voltage is possible
- high accuracy output voltage .....±2.5%
- low temperature drift coefficient of output voltage .....TYP. ±100ppm/°C
- excellent line regulation .....Typ. 0.1%/V
- three types of packages .....RE5RL .....TO-92  
RH5RL .....SOT-89  
RN5RL .....SOT-23-5

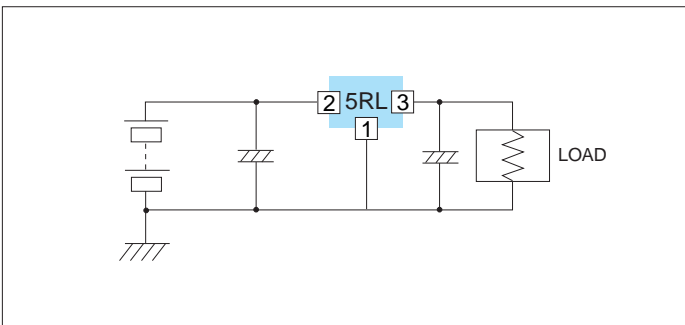
### Block Diagram



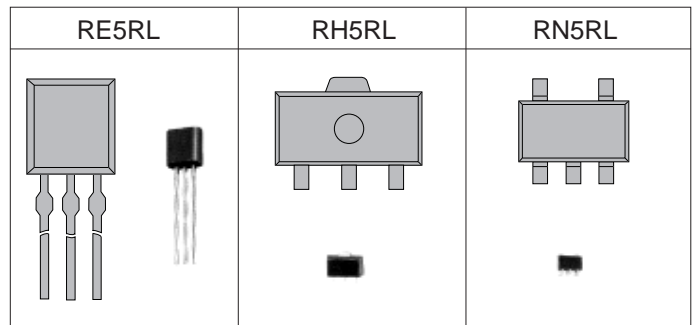
### Typical Characteristics R×5RL50A



### Typical Circuit Configuration



### Packages



### Applications

- power source for battery-powered equipment
- power source for cameras, video equipment such as camcorders and VCRs, and hand-held communication devices
- precision voltage references

# RQ5RW Series

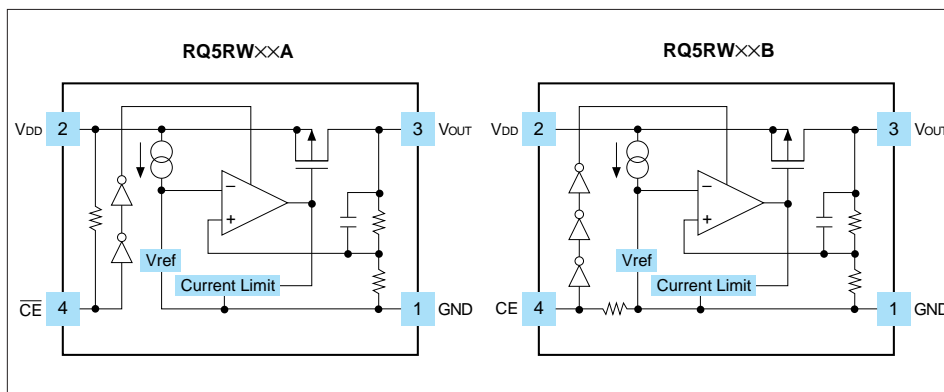
## Small Package Voltage Regulator

The RQ5RW series are voltage regulator ICs with high accuracy output voltage and ultra-low supply current. Each model consists of a voltage reference unit, an error amplifier, resistors for setting output voltage and a current limit circuit.

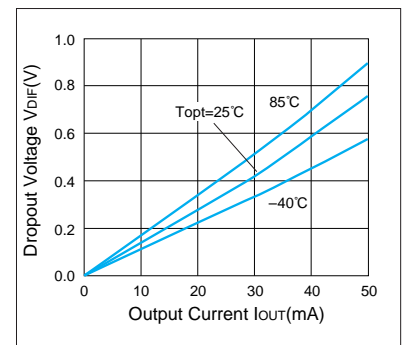
### Features

- ultra-low supply current .....TYP. 1.5 $\mu$ A
- standby current .....TYP. 0.1 $\mu$ A
- dropout voltage .....TYP. 40mV ( $I_{OUT}=1\text{mA}$ , RQ5RW30A/B)
- high accuracy output voltage ..... $\pm 2.0\%$
- low temperature-drift coefficient of output voltage .....TYP.  $\pm 100\text{ppm}/^\circ\text{C}$
- excellent line regulation .....TYP. 0.05%/V
- built-in current limit circuits
- provided two types of chip enable circuit .....“L” active (RQ5RW $\times\times$ A), “H” active (RQ5RW $\times\times$ B)
- ultra-small package .....SC-82AB (Super Mini-mold)

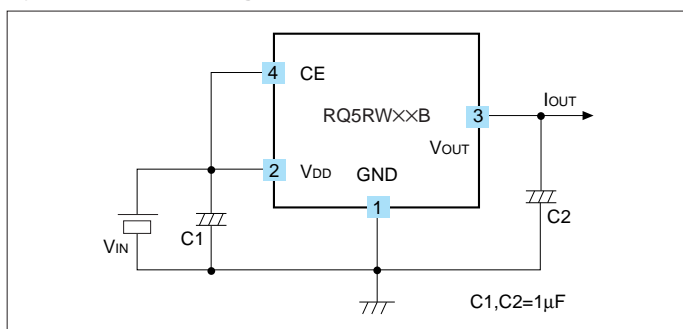
### Block Diagram



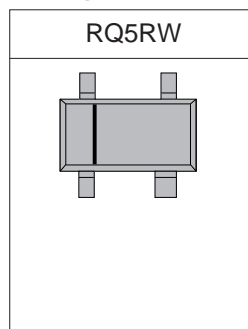
### Typical Characteristics RQ5RW50BX



### Typical Circuit Configuration



### Packages



### Applications

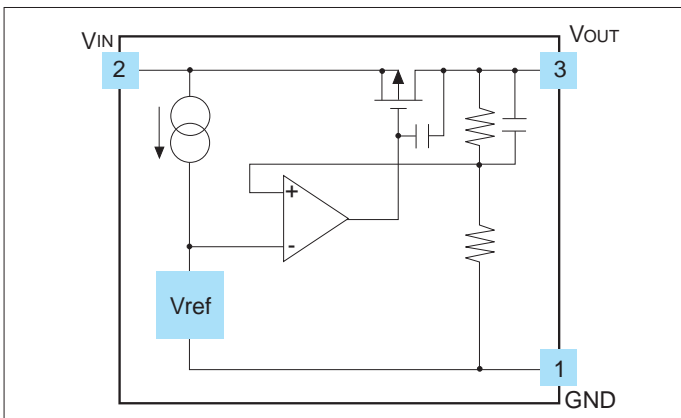
- power source for battery-powered equipment.
- power source for cameras, VCRs, camcorders, hand-held audio instruments and hand-held communication equipment.
- precision voltage references.

The R×5RE series are CMOS voltage regulator ICs for large output current with high accuracy output voltage and ultra low quiescent current. The dropout voltage of the R×5RE is even smaller than that of the R×5RL. Each model consists of a voltage reference unit, an error amplifier, a driver transistor, resistors for setting output voltage, and a current limit circuit.

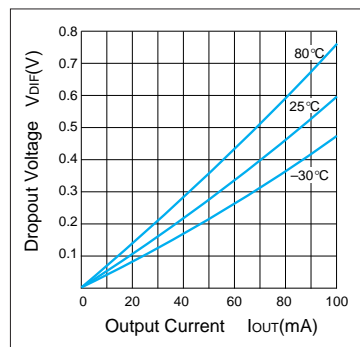
### Features

- high output current .....TYP. 120mA (R×5RE50A)
- ultra-low quiescent current.....TYP. 1.1μA (R×5RE30A,  $V_{IN}=5.0V$ )
- small dropout voltage .....TYP. 0.5V (R×5RE50A,  $I_{OUT}=60mA$ )
- high accuracy output voltage .....±2.5%
- low temperature drift coefficient of output voltage .....TYP. ±100ppm/°C
- excellent line regulation .....TYP. 0.1%/V
- two types of packages .....RE5RE .....TO-92  
RH5RE .....SOT-89

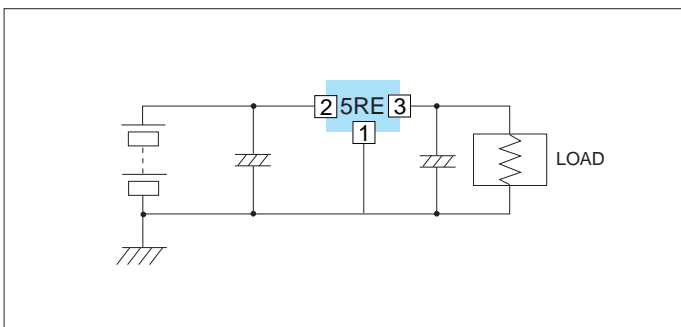
### Block Diagram



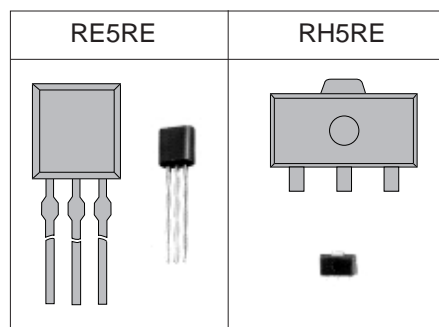
### Typical Characteristics R×5RE50A



### Typical Circuit Configuration



### Packages



### Applications

- power source for battery-powered equipment
- power source for cameras, video equipment such as camcorders and VCRs, and hand-held communication devices
- precision voltage references

# RN5RG Series

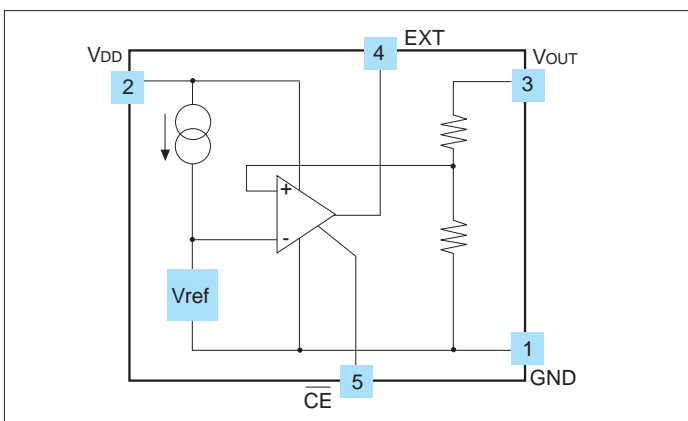
## Voltage Regulator with External Power Transistor

The RN5RG series are CMOS voltage regulator ICs with external power transistor, ultra-low supply current and high accuracy output voltage. Each model consists of a voltage reference unit, an error amplifier, and resistors for setting output voltage.

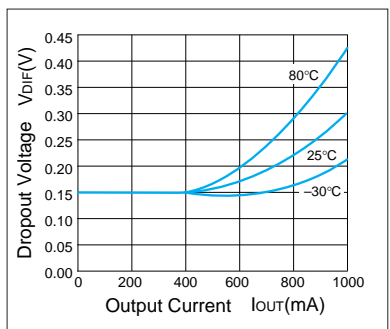
### Features

- ultra-low supply current .....TYP. 50 $\mu$ A (RN5RG30A)
- ultra-low supply current (stand-by mode).....TYP. 0.2 $\mu$ A (RN5RG30A)
- small dropout voltage .....TYP. 0.1V ( $I_{OUT}$ =100mA; depending upon the external power transistor)
- high accuracy output voltage ..... $\pm$ 2.5%
- low temperature drift coefficient of output voltage .....TYP.  $\pm$ 100ppm/ $^{\circ}$ C
- excellent line regulation .....TYP. 0.1%/V
- small package .....SOT-23-5

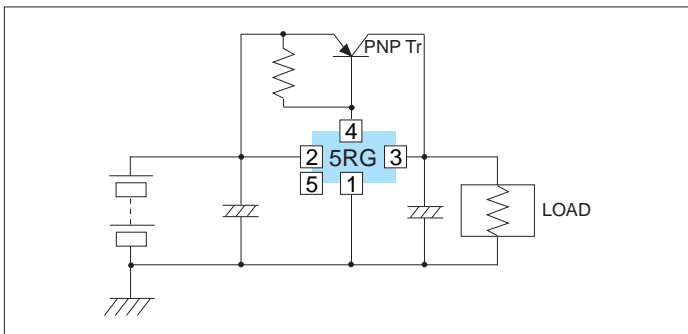
### Block Diagram



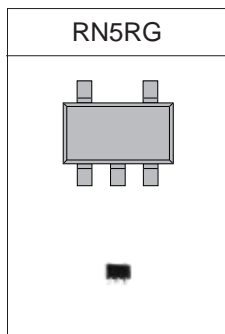
### Typical Characteristics RN5RG50A



### Typical Circuit Configuration



### Package



### Applications

- power source for battery-powered equipment
- power source for cameras, video equipment such as camcorders and VCRs, and hand-held communication devices
- precision voltage references

# RN5RF Series

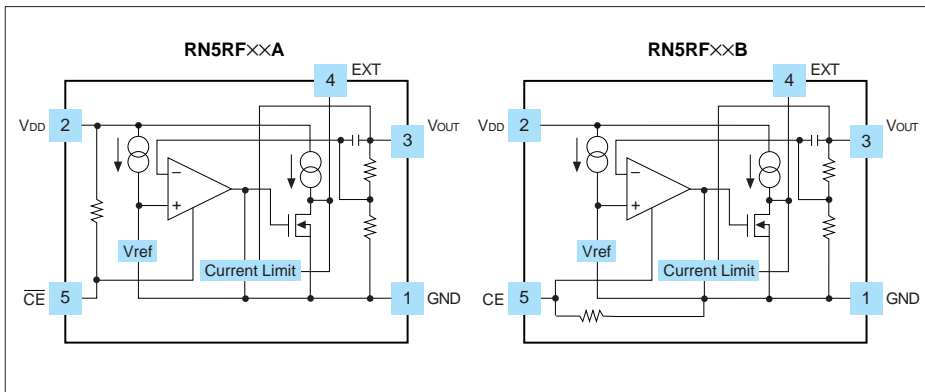
## Low Ripple Voltage Regulator with External Transistor

The RN5RF series are voltage regulator ICs which control external driver transistors with high ripple rejection, high accuracy output voltage, low supply current. Each model consists of a voltage reference unit, an error amplifier, output voltage setting resistor, short circuit, current limiting circuit and chip enable circuit.

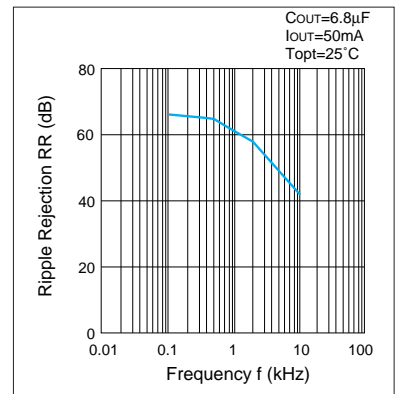
### Features

- ultra low supply current .....TYP. 30 $\mu$ A
- ultra low standby current .....TYP. 0.1 $\mu$ A
- low dropout voltage .....TYP. 0.1V/ $I_{OUT}=100$ mA, dependent on external power transistor.
- output voltage .....stepwise setting with a step of 0.1V in the range of 2.0V to 6.0V
- high accuracy output voltage ..... $\pm 2.0\%$
- low temperature-drift coefficient of output voltage .....TYP.  $\pm 100$ ppm/ $^{\circ}$ C
- high line regulation .....TYP. 0.05%/V
- current limit for external transistor .....TYP. 8mA, limit a base current
- high ripple rejection .....TYP. 60dB/ $f=1$ kHz
- small package .....SOT-23-5

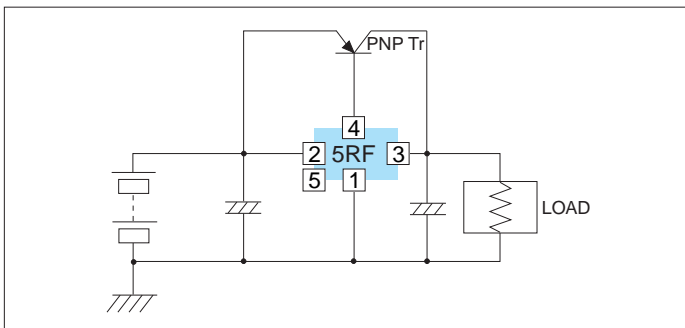
### Block Diagram



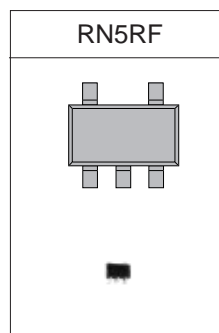
### Typical Characteristics RN5RF50



### Typical Circuit Configuration



### Package



### Applications

- power source for battery-powered equipment
- telecommunications, cameras, VCRs
- power source for domestic appliances

# RN5RT Series

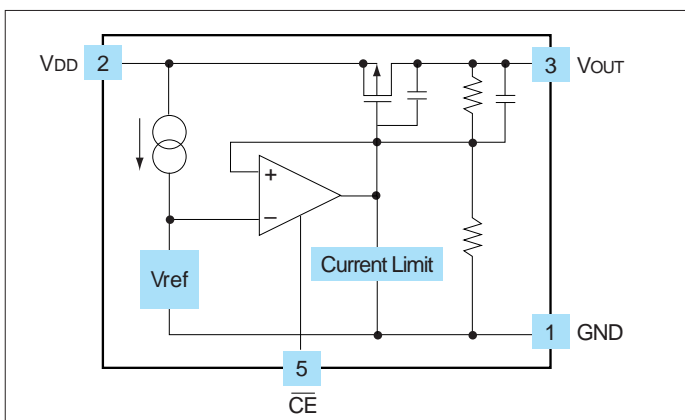
## Low Drop-out Voltage Regulator

The RN5RT series are voltage regulator ICs built-in driver transistor of low ON resistance permits developing of low dropout voltage. Each model consists of a voltage reference unit, an error amplifier, output voltage setting resistors and a current limit circuit and chip enable circuit.

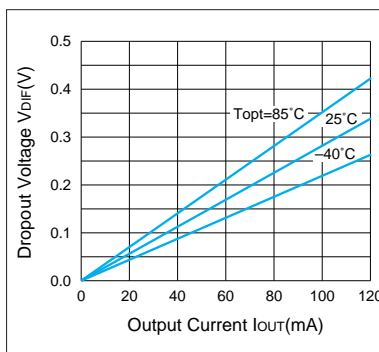
### Features

- ultra-low supply current .....TYP. 4 $\mu$ A (except I<sub>CEL</sub>)
- ultra-low standby current .....TYP. 0.1 $\mu$ A
- low dropout voltage .....TYP. 0.3V (I<sub>OUT</sub>=60mA, RN5RT30A)
- low temperature-drift coefficient of output voltage .....TYP.  $\pm$ 100ppm/ $^{\circ}$ C
- excellent line regulation .....TYP. 0.15%/V
- output voltage .....stepwise setting with a step of 0.1V in the range of 2.0V to 6.0V is possible.
- high accuracy output voltage ..... $\pm$ 2.0%
- built-in current limit circuits .....TYP. 30mA
- small package .....SOT-23-5

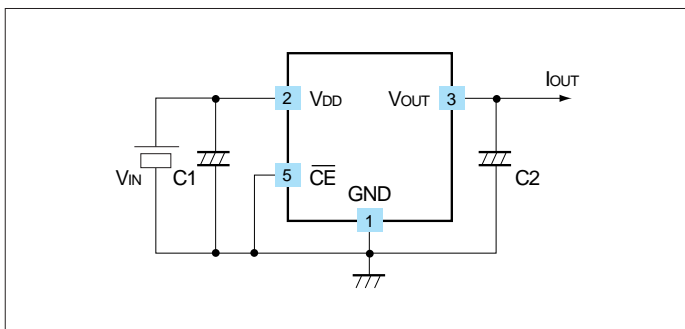
### Block Diagram



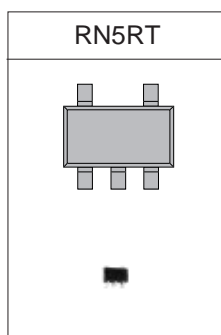
### Typical Characteristics RN5RT50AX



### Typical Circuit Configuration



### Package



### Applications

- power source for battery-powered equipment.
- power source for cellular phones, cameras, VCRs, camcorders, hand-held audio instruments and hand-held communication equipment.
- power source for domestic appliances.

# RN5RZ Series

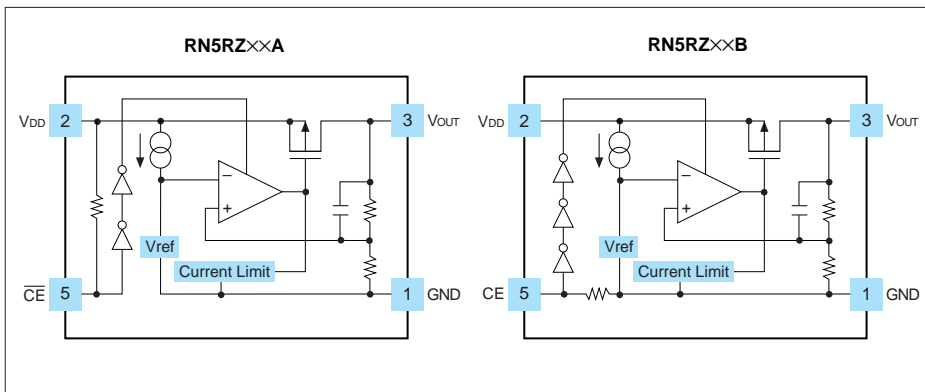
## Low Drop-out and Low Noise Voltage Regulator

Voltage regulator ICs with low dropout voltage and high ripple rejection. Each model consists of a voltage reference unit, an error amplifier, output voltage setting resistors, a current limit circuit and a chip enable circuit. These ICs have superior ripple rejection, input transient response characteristic and load transient response characteristic thus making these product suitable for power supply for hand-held communication equipment.

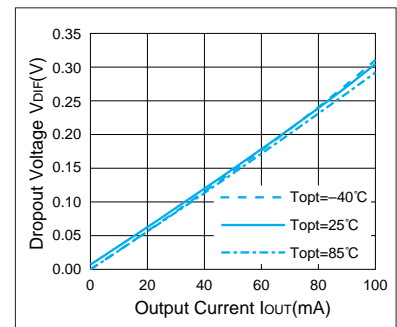
### Features

- ultra-low supply current .....TYP. 20 $\mu$ A
- ultra-low standby current .....TYP. 0.1 $\mu$ A
- high ripple rejection .....TYP.55dB (f=1kHz)
- low dropout voltage .....TYP. 0.2V (I<sub>OUT</sub>=60mA)
- low temperature-drift coefficient of output voltage .....TYP.  $\pm$ 100ppm/ $^{\circ}$ C
- excellent line regulation .....TYP. 0.05%/V
- output voltage .....stepwise setting with a step of 0.1V in the range of 2.0V to 6.0V is possible
- high accuracy output voltage ..... $\pm$ 2.0%
- small package .....SOT-23-5
- built-in short current limit circuit .....TYP. 50mA

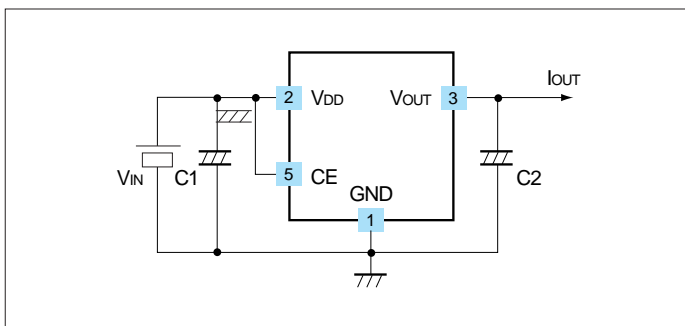
### Block Diagram



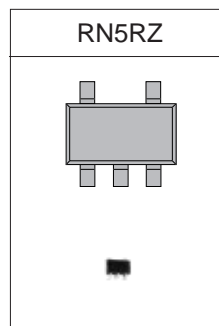
### Typical Characteristics RN5RZ50B



### Typical Circuit Configuration



### Package



### Applications

- power source for battery-powered equipment.
- power source for cellular phones, cameras, VCRs, camcorders, hand-held audio instruments and hand-held communication equipment.
- power source for domestic appliances.

# R1110N Series

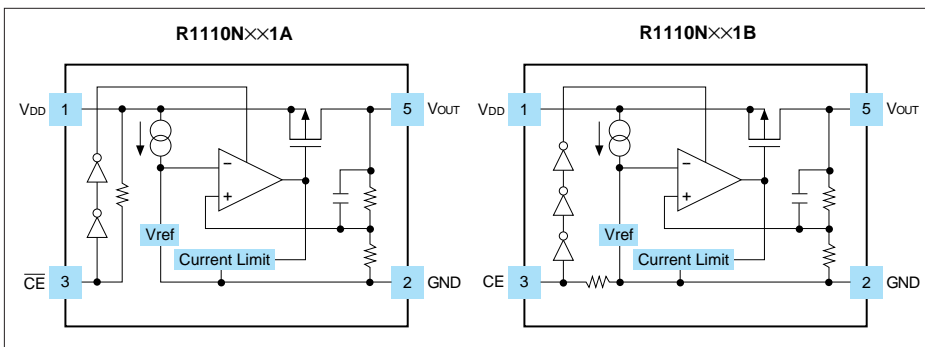
## Low Noise 150mA L.D.O. Regulator

The R1110N series are voltage regulator ICs with high output voltage accuracy, lowest supply current, low ON resistance and high ripple rejection. Each model consists of a voltage reference unit, an error amplifier, resistors, a current limit circuit and a chip enable circuit. The Dynamic Response to line and load is fast, so these ICs are very suitable for the power supply for handheld communication equipment.

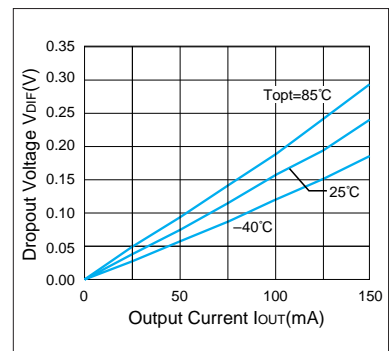
### Features

- ultra-low supply current .....TYP. 35 $\mu$ A
- ultra-low standby current .....TYP. 0.1 $\mu$ A
- dropout voltage .....TYP. 0.2V ( $I_{OUT}=100$ mA)
- high ripple rejection .....TYP. 70dB ( $f=1$ kHz)
- high accuracy output voltage ..... $\pm 2.0\%$
- low temperature-drift coefficient of output voltage .....TYP.  $\pm 100$ ppm/ $^{\circ}$ C
- excellent line regulation .....TYP. 0.05%/V
- output voltage .....stepwise setting with a step of 0.1V in the range of 2.0V to 6.0V is possible
- built-in short current limit circuit .....TYP. 50mA
- provided two types of chip enable circuit .....“L” active (R1110N $\times\times$ 1A), “H” active (R1110N $\times\times$ 1B)
- small package .....SOT-23-5
- pinout .....similar to the LP2980

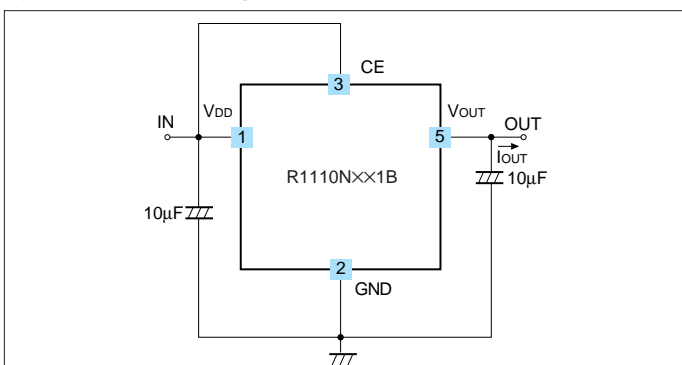
### Block Diagram



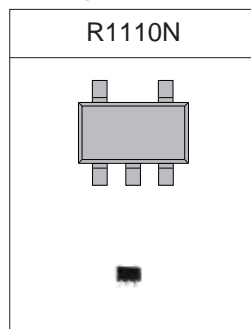
### Typical Characteristics R1110N501B



### Typical Circuit Configuration



### Packages



### Applications

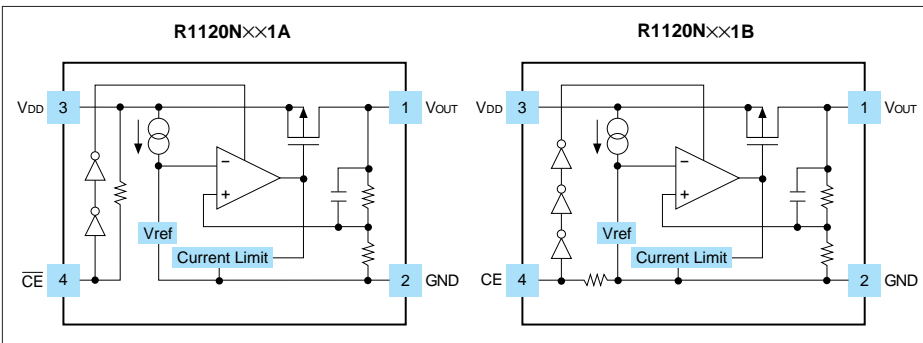
- power source for portable communication tools, cameras and VCRs.
- power source for battery-powered equipment.
- power source for domestic appliances.

R1120N series are voltage regulator ICs with high output voltage accuracy, lowest supply current, low ON resistance and high ripple rejection. Each model consists of a voltage reference unit, an error amplifier, resistors, a current limit circuit and a chip enable circuit. The Dynamic Response to line and load is fast, so these ICs are very suitable for the power supply for handheld communication equipment.

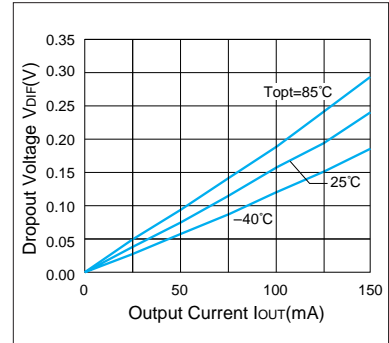
### Features

- ultra-low supply current .....TYP. 35 $\mu$ A
- ultra-low standby current .....TYP. 0.1 $\mu$ A
- dropout voltage .....TYP. 0.2V ( $I_{OUT}=100$ mA)
- high ripple rejection .....TYP. 70dB ( $f=1$ kHz)
- high accuracy output voltage ..... $\pm 2.0\%$
- low temperature-drift coefficient of output voltage .....TYP.  $\pm 100$ ppm/ $^{\circ}$ C
- excellent line regulation .....TYP. 0.05%/V
- output voltage .....stepwise setting with a step of 0.1V in the range of 2.0V to 6.0V is possible
- built-in short current limit circuit .....TYP. 50mA
- provided two types of chip enable circuit .....“L” active (R1120N $\times\times$ 1A), “H” active (R1120N $\times\times$ 1B)
- small package .....SOT-23-5
- pinout .....similar to the TK112

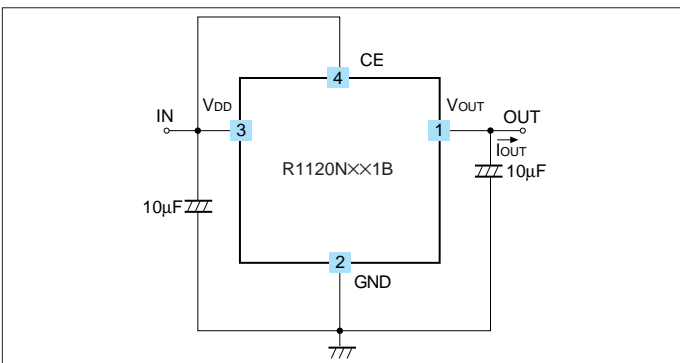
### Block Diagram



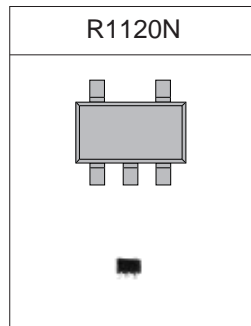
### Typical Characteristics R1120N501B



### Typical Circuit Configuration



### Packages



### Applications

- Power source for portable communication tools, cameras and VCRs.
- Power source for battery-powered equipment.
- Power source for domestic appliances.

# CMOS DC/DC Converters

## RH5RH Series

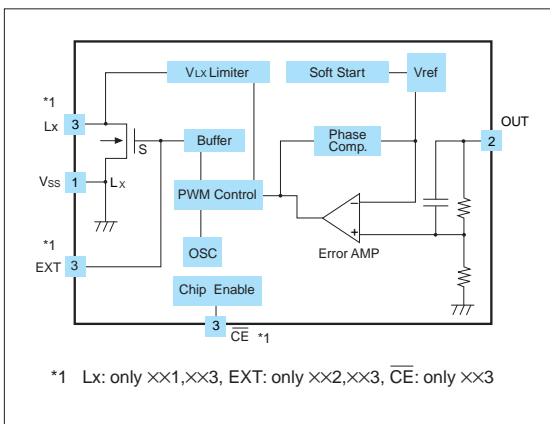
## PWM Step-Up DC/DC Converter

The RH5RH series are PWM step-up DC/DC converter ICs with high accuracy output voltage and low supply current. Each model consists of an oscillator, a PWM control circuit, a driver transistor, a voltage reference unit, a phase compensation circuit, resistors for voltage monitoring, a soft-start circuit and an Lx switch protection circuit. Available in Normal (××1), Boost (××2) and Stand-by (××3).

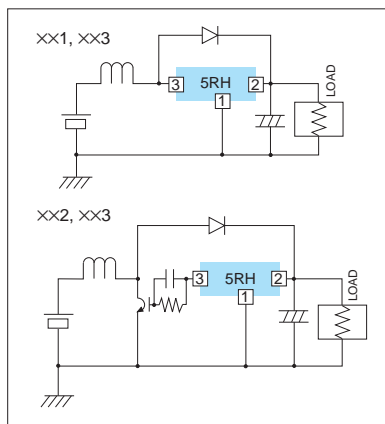
### Features

- minimal external components.....Only an inductor, a diode, and a capacitor
- low supply current .....TYP. 30µA (RH5RH501)
- low-ripple and low-noise
- low voltage operation possible (at 1mA output current) .....operation voltage  $V_{IN}=0.9$  to 8.0V
- high accuracy output voltage .....±2.5%
- high efficiency .....TYP. 80%
- low temperature drift coefficient of output voltage .....TYP. ±50ppm/°C
- soft-start function .....MIN. 500µs

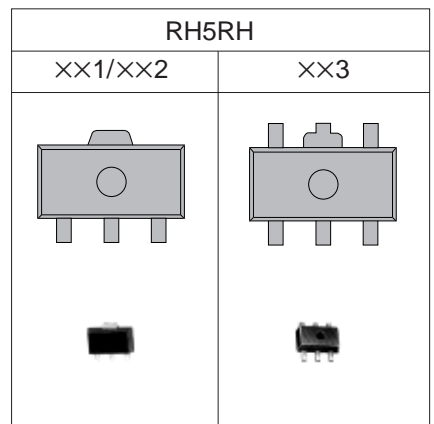
### Block Diagram



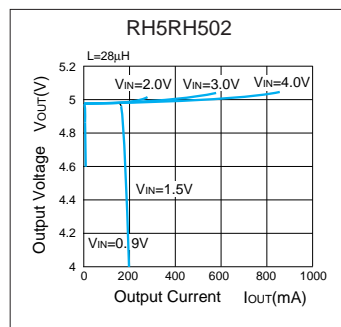
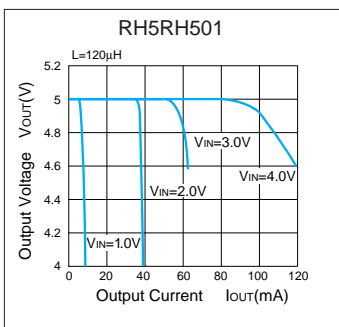
### Typical Circuit Configuration



### Packages



### Typical Characteristics



### Applications

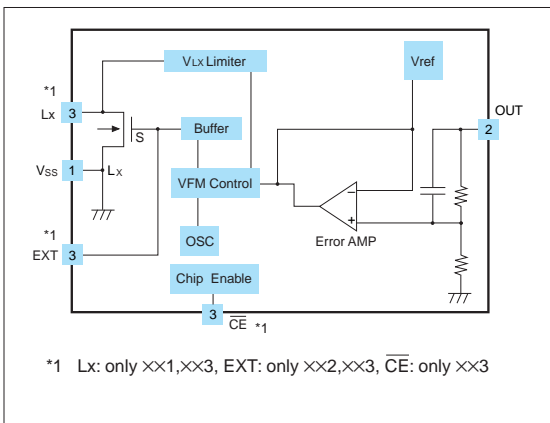
- power source for battery-powered equipment
- power source for cameras, camcorders, VCRs, PDAs, electronic data banks, and hand-held communication devices
- power source for devices which require low noise and low supply current, such as hand-held audio equipment (only RH5RH series)
- power source for appliances which require higher cell voltage than that of the batteries used in the appliances

RH5RI series are VFM step-up DC/DC converter ICs with high accuracy output voltage and low supply current. Each model consists of an oscillator, a VFM control circuit, a driver transistor, a voltage reference unit, resistors for voltage monitoring, and an Lx switch protection circuit. Available in Normal (××1), Boost (××2) and Stand-by (××3).

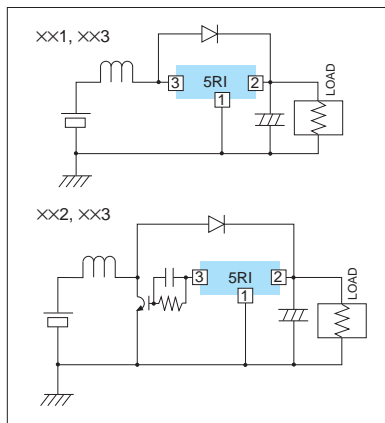
### Features

- minimal external components ..... Only an inductor, a diode, and a capacitor
- low supply current ..... TYP. 4μA (RH5RI301, V<sub>IN</sub>=1.5V at no load)
- low-ripple and low-noise
- low voltage operation possible (at 1mA output current) ..... operation voltage V<sub>IN</sub>=0.9 to 8.0V
- high accuracy output voltage ..... ±2.5%
- high efficiency ..... TYP. 80%
- low temperature drift coefficient of output voltage ..... TYP. ±50ppm/°C

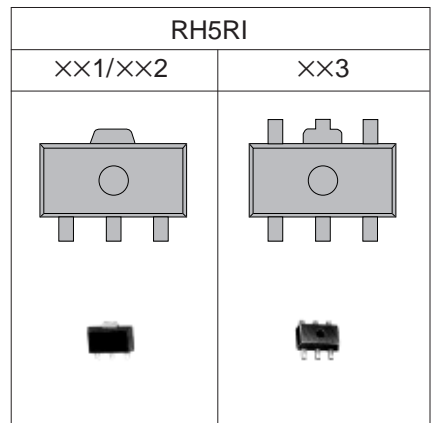
### Block Diagram



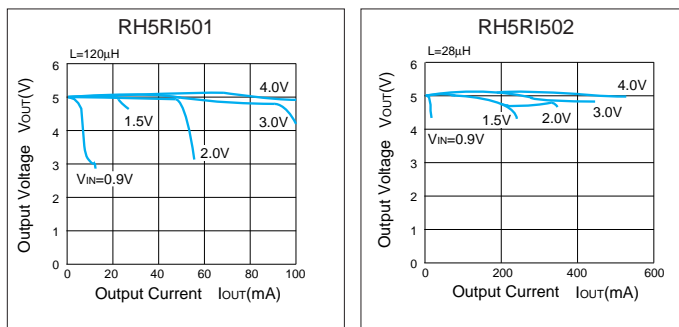
### Typical Circuit Configuration



### Packages



### Typical Characteristics



### Applications

- power source for battery-powered equipment
- power source for cameras, camcorders, VCRs, PDAs, electronic data banks, and hand-held communication devices
- power source for devices which require low noise and low supply current, such as hand-held audio equipment (only RH5RH series)
- power source for appliances which require higher cell voltage than that of the batteries used in the appliances

# RN5RK Series

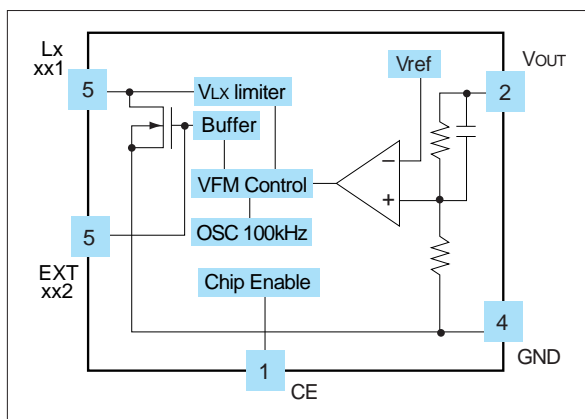
## VMF Step-Up Small DC/DC Converter

The RN5RK Series are VFM (Chopper) Step-up DC/DC converter ICs, consist of an oscillator, a VFM control circuit, a driver transistor to have low ON resistance (Lx switch), a voltage reference unit, a high speed comparator, resistors for voltage detection, an Lx switch protection circuit and an internal chip enable circuit. Available in Normal (××1), Boost (××2).

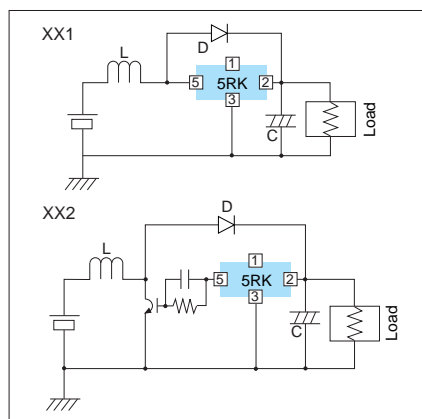
### Features

- small number of external components .....only an inductor, a diode and a capacitor(RN5RK××1A/××1B)
- ultra low Input current on standby .....MAX. 0.5μA
- low temperature-drift coefficient of output voltage .....TYP. ±100ppm/°C
- low ripple and low noise
- low start-up voltage .....MAX. 0.9V
- high efficiency .....TYP. 80%
- including a driver transistor with low ON resistance
- two kinds of duty ratio .....77% (××1A, ××2A)/ 55% (××1B)
- output voltage .....stepwise setting with a step of 0.1V in the range of 2.0V to 5.5V is possible
- high output voltage accuracy.....±2.5%
- small packages.....SOT-23-5

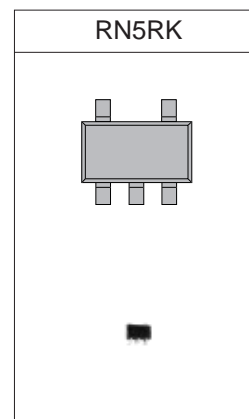
### Block Diagram



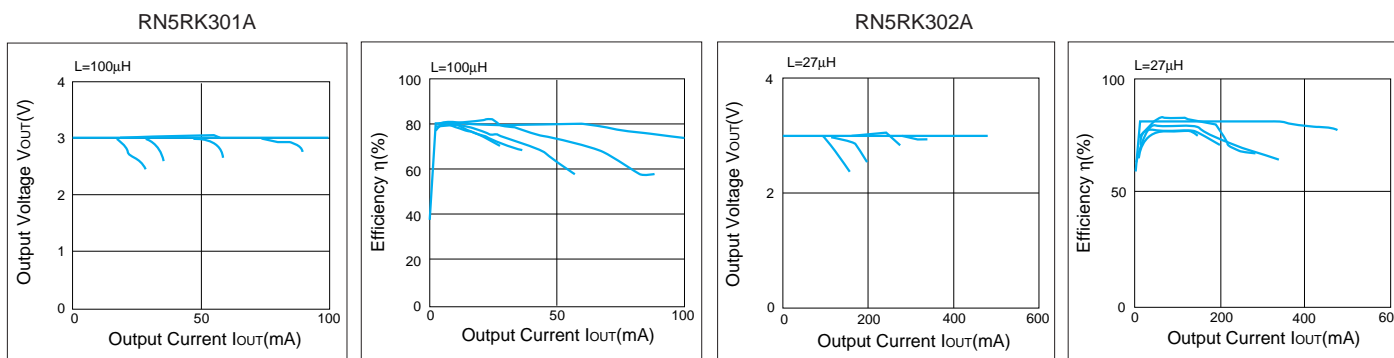
### Typical Circuit Configuration



### Package



### Typical Characteristics



### Applications

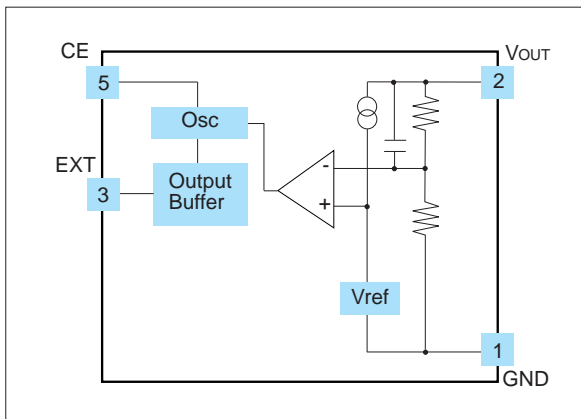
- power source for battery -powered equipment.
- power source for cameras, camcorders, VCRs, and hand-held communication e equipment.
- power source for those appliances which require higher cell voltage than that of batteries.

RN5RY××1A series are VFM Step-up DC/DC converter controller ICs with external power transistor featuring a high accuracy of output voltage and low supply current. These ICs consist of an oscillator, a VFM control circuit, a voltage reference unit and feedback resistors. The package for these ICs is, much smaller than that of RH5RI××2B/××3B, SOT-23-5 package.

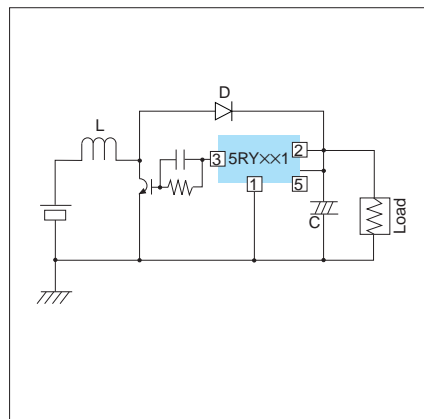
### Features

- low supply current .....TYP. 3 $\mu$ A
- low standby current .....TYP. 0.6 $\mu$ A
- low temperature-drift coefficient of output voltage .....TYP.  $\pm$ 50ppm/ $^{\circ}$ C
- high accuracy output voltage ..... $\pm$ 2.5%
- low oscillation start-up voltage .....MAX. 0.8V
- small package .....SOT-23-5

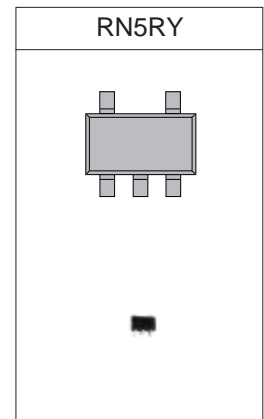
### Block Diagram



### Typical Circuit Configuration

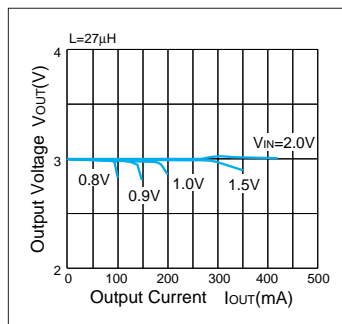


### Package

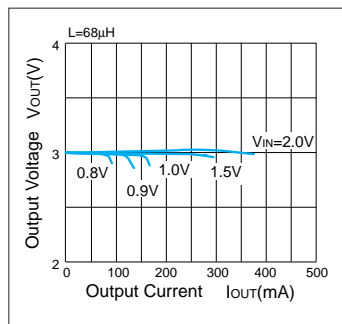


### Typical Characteristics

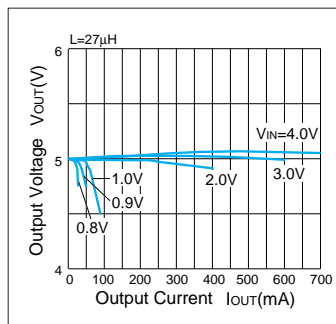
RN5RY301



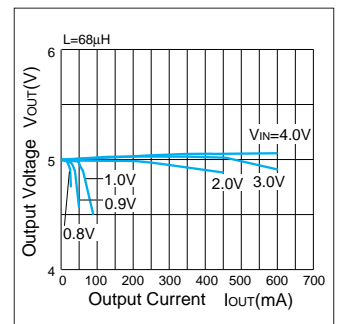
RN5RY301



RN5RY501



RN5RY501



### Applications

- power source for battery-powered instruments
- power source for cameras, VCRs, camcorders, pagers, and other hand-held communication instruments

# RN5RY202A

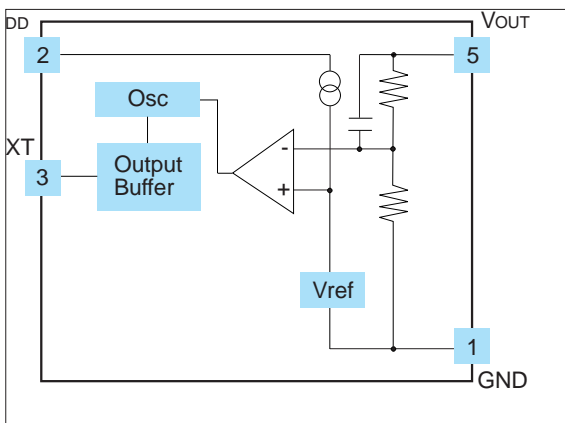
## VFM Step-Up DC/DC Converter Controller

RN5RY202A is a VFM Step-up DC/DC converter controller IC with external driver transistor featuring a high accuracy of output voltage and low supply current. This IC consists of an oscillator, a VFM control circuit, a voltage reference unit and feedback resistors. Being different from RN5RY××1A, this IC is able to adjust output voltage with external power transistor. (e.g.  $V_{IN}=3V$  then  $V_{OUT}=30V$  available.)

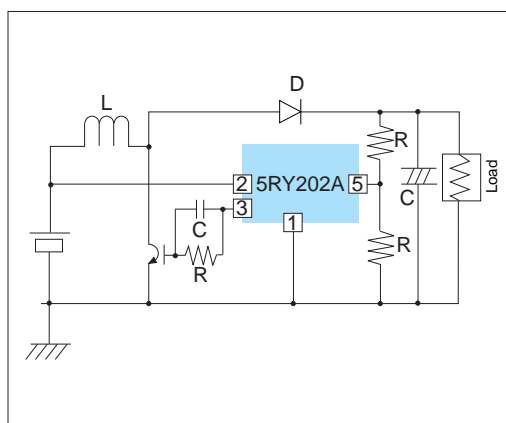
### Features

- ultra-low supply current .....TYP.  $3.0\mu A$
- low temperature-drift coefficient of output voltage .....TYP.  $\pm 50\text{ppm}/^\circ C$
- high accuracy output voltage (fixed to 2.0V internally) ..... $\pm 2.5\%$
- adjustable output voltage by external resistors
- low oscillation start-up voltage .....MAX. 0.8V
- small package .....SOT-23-5

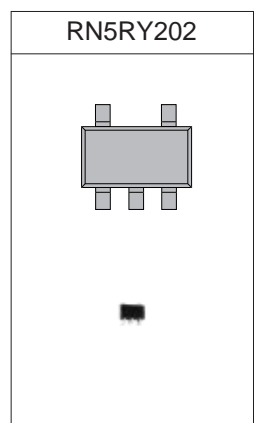
### Block Diagram



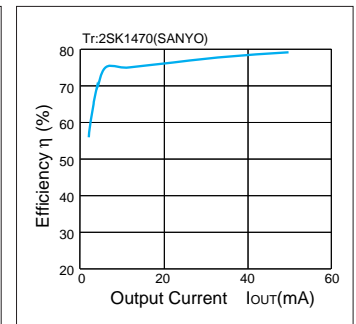
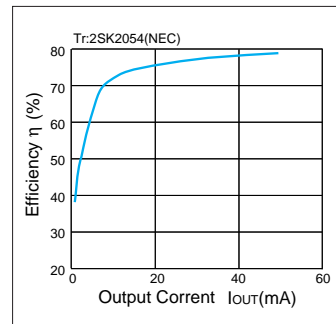
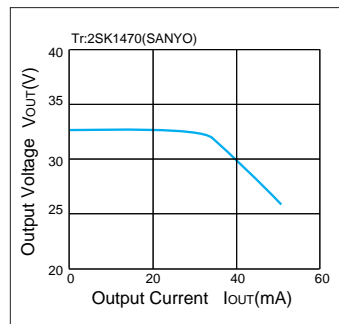
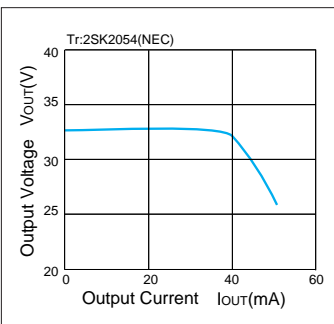
### Typical Circuit Configuration



### Packages



### Typical Characteristics



### Applications

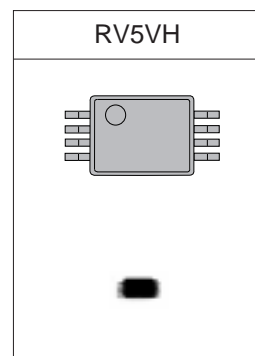
- power source for battery-powered instruments
- power source for cameras, VCRs, camcorders, pagers, and other hand-held communication instruments
- power source for LCD drivers, organizers, cellular phones and other hand-held instruments

The RV5VH series are dual output CMOS DC/DC converter ICs integrating a VFM Step-up DC/DC converter and inverting DC/DC converters and voltage detector. Each model consists of an oscillator, two VFM control circuits, control transistors(EXT switches), a phase compensation circuit, a voltage reference unit, an error amplifier, and voltage sensing resistors. The RV5VH series are suitable for two supply systems such as pager, PDA, which need power supplies for LCD. Comes in three models: Normal (1xx), Boost (2xx), Boost and Voltage Adjustable (3xx).

### Features

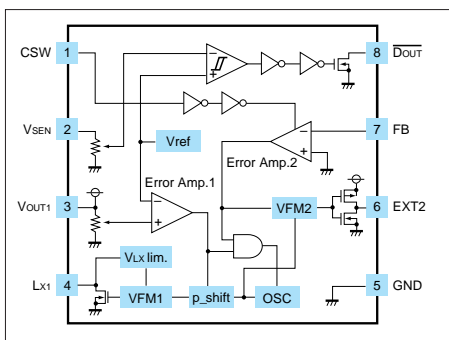
- dual DC/DC converter system .....DC/DC1 : step-up  
DC/DC2 : inverting(negative voltage)
- voltage detector .....Nch. Open Drain Output
- low voltage operation available  
RV5VH1xx, RV5VH2xx .....oscillator start-up from 0.8V  
RV5VH3xx .....oscillator start-up from 1.8V
- high efficiency .....TYP. 80%
- low supply current
- high accuracy feedback sensing .....TYP.  $\pm 2.5\%$
- sleep mode  
RV5VH1xx, RV5VH2xx .....DC/DC 2  
RV5VH3xx .....DC/DC1, 2
- available to adjust temperature drift coefficient of output voltage .....DC/DC2 : with external resistor  
(RV5VH2xx, RV5VH3xx)
- small package .....8pin SSOP(0.65mm pitch)

### Packages

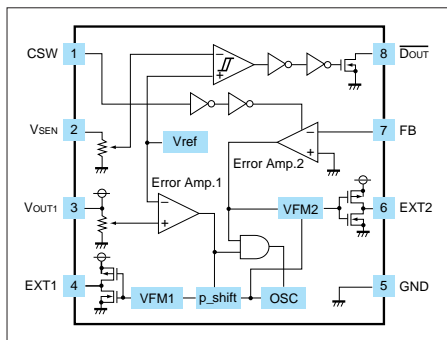


### Block Diagram

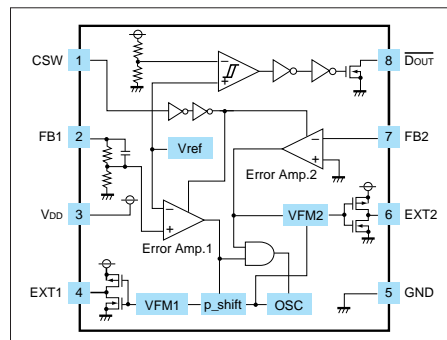
#### • RV5VH1xx



#### • RV5VH2xx

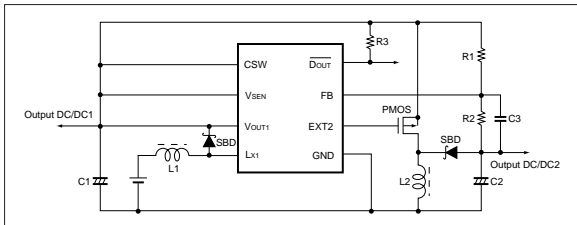


#### • RV5VH3xx

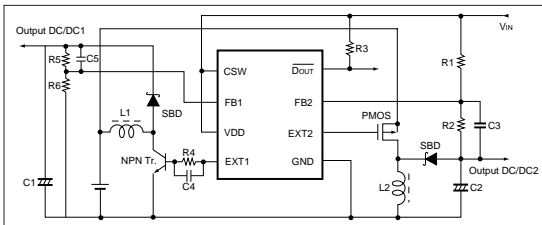


### Typical Circuit Configuration

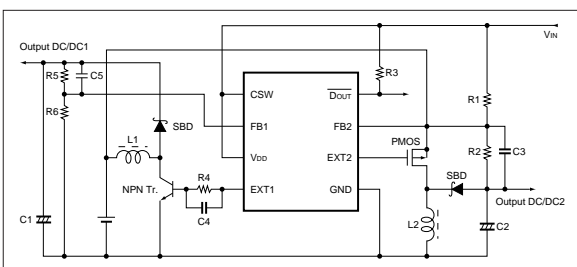
#### • RV5VH1xx



#### • RV5VH2xx



#### • RV5VH3xx



### Applications

- power source for telecommunication system
- power source for portable data processing system, e.g. PDA, Electronic Data Banks
- power source for Audio-Visual system, e.g. CD player, Video camera
- power source for Notebook PC, Word processing system
- gadget being needed two power supplies, e.g. CPU and LCD

# RS5RM Series

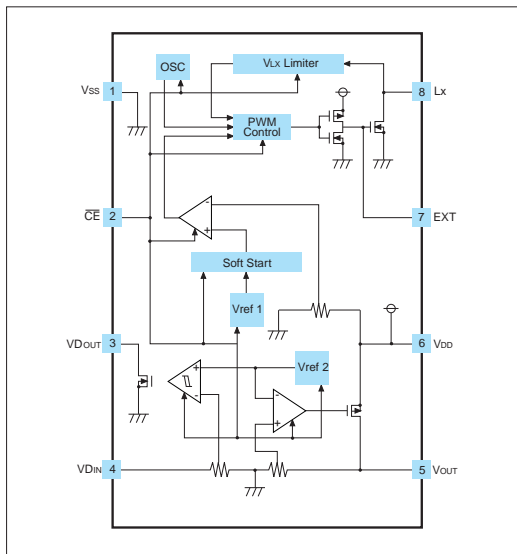
## PWM Step-up DC/DC Converter with Voltage Regulator and Detector

The RS5RM series are PWM step-up DC/DC converter ICs with high accuracy output voltage and low supply current. Each model consists of an oscillator, a PWM control circuit, soft start circuit, a driver transistor, a voltage reference unit, a linear regulator and a voltage detector. With external inductor, diode and capacitor, an RS5RM operates as a linear regulator if the input voltage is high and as a PWM step-up DC/DC converter and a linear regulator if the input voltage is low.

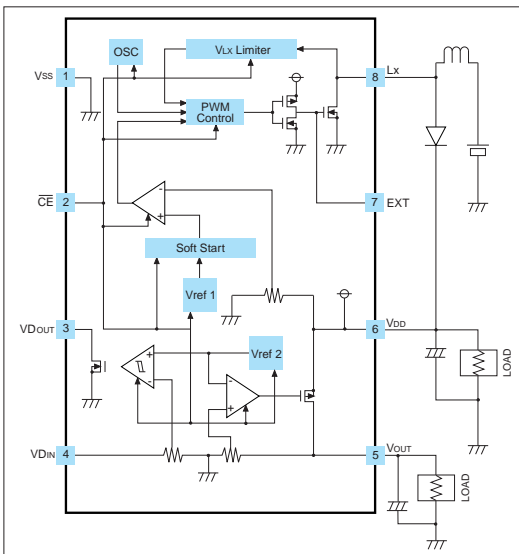
### Features

- low supply current .....55 $\mu$ A (RS5RM3624A;  $V_{IN}=3.0V$ , at no load)
- standby mode .....Istandby = MAX. 1.0 $\mu$ A (RS5RMXXXA)  
operation of all the internal circuits is stopped by setting  $\overline{CE}$  pin at  $V_{DD}$  level.  
Istandby = MAX. 10 $\mu$ A (RS5RMXXXB)  
operation of only step-up DC/DC converter is stopped by setting  $\overline{CE}$  pin at  $V_{DD}$  level.
- low voltage operation possible.....operation voltage  $V_{IN}=1.2$  to 10.0V
- high accuracy output voltage and detector threshold ..... $\pm 2.5\%$
- output voltage can be set at User's request
- voltage close to battery's voltage can be output because these ICs are step-up and step-down type  
(e.g. a fixed voltage of 3V can be output by a 3V battery)
- soft start function, with built-in protection circuit for Lx driver
- pin for external driver is equipped, and a large current output can be obtained
- small package .....8 pin SOP (1.27mm pitch)

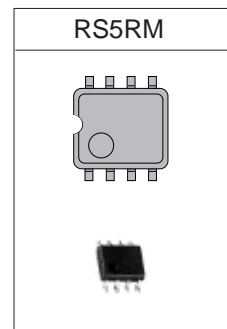
### Block Diagram



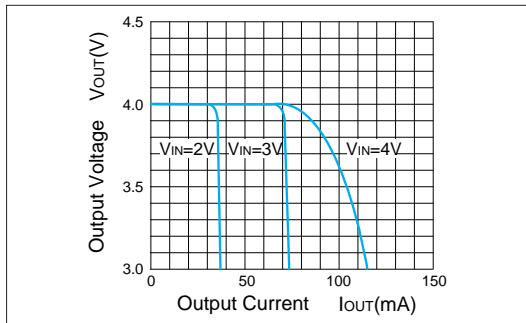
### Typical Circuit Configuration



### Package



### Typical Characteristics RS5RM4036A



### Applications

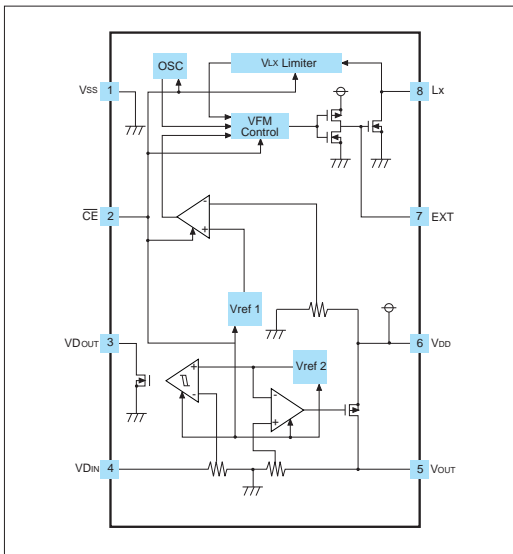
- power source for cameras, camcorders, and hand-held audio equipment
- power source for small OA apparatus such as notebook computers and word processors
- power source for hand-held communication devices such as pagers, cordless telephones, and cellular phones

RS5RJ series are VFM step-up DC/DC converter ICs with high accuracy output voltage and low supply current. Each model consists of an oscillator, a VFM control circuit, a driver transistor, a voltage reference unit, a linear regulator and a voltage detector. With external inductor, diode and capacitor, an RS5RJ operates as a linear regulator if the input voltage is high and as a VFM step-up DC/DC converter and a linear regulator if the input voltage is low.

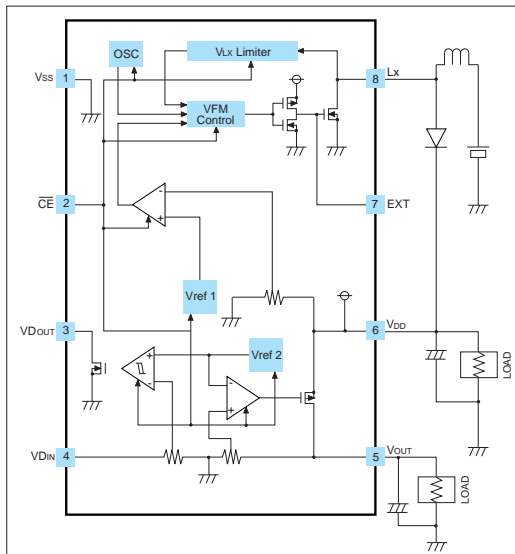
### Features

- low supply current .....15 $\mu$ A (RS5RJ3624A;  $V_{IN}$ =3.0V, at no load)
- standby mode .....Istandby = MAX. 1.0 $\mu$ A (RS5RJXXXA)  
operation of all the internal circuits is stopped by setting  $\overline{CE}$  pin at  $V_{DD}$  level.  
Istandby = MAX. 10 $\mu$ A (RS5RJXXXB)  
operation of only step-up DC/DC converter is stopped by setting  $\overline{CE}$  pin at  $V_{DD}$  level.
- low voltage operation possible.....operation voltage  $V_{IN}$ =1.2 to 10.0V
- high accuracy output voltage and detector threshold ..... $\pm 2.5\%$
- output voltage can be set at User's request
- voltage close to battery's voltage can be output because these ICs are step-up and step-down type (e.g. a fixed voltage of 3V can be output by a 3V battery)
- built-in protection circuit for Lx driver
- pin for external driver is equipped, and a large current output can be obtained
- small package .....8 pin SOP (1.27mm pitch)

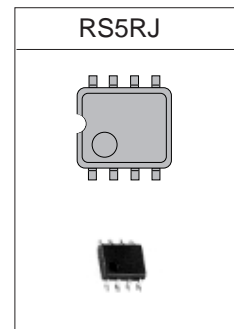
### Block Diagram



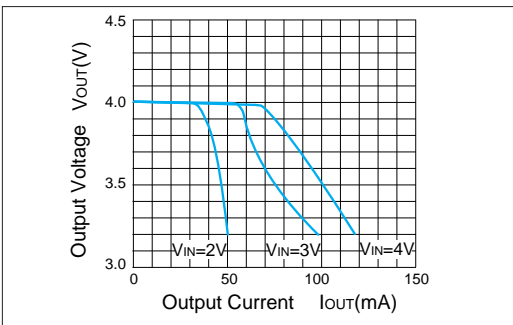
### Typical Circuit Configuration



### Package



### Typical Characteristics RS5RJ4036A



### Applications

- power source for cameras, camcorders, and hand-held audio equipment
- power source for small OA apparatus such as notebook computers and word processors
- power source for hand-held communication devices such as pagers, cordless telephones, and cellular phones

# CMOS Multi-Power Supply

## R×5VE0××× Series

## Multi-Power Supply

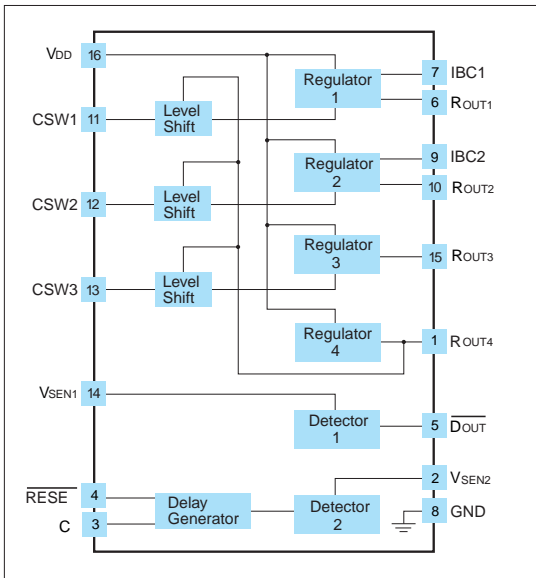
The R×5VE0××× series consists of four different series regulators, two different voltage detectors, three control switches, three level shifters, and a delay generator. The R×5VE001× is a standard version for voltage setting by laser trimming. The R×5VE0××× is a model for semi-custom-designed control switches and other functions for your specific system with mask options of your choice. The regulator output voltage and the detector threshold can be set independently within the IC by using laser trimming technology.

### Features

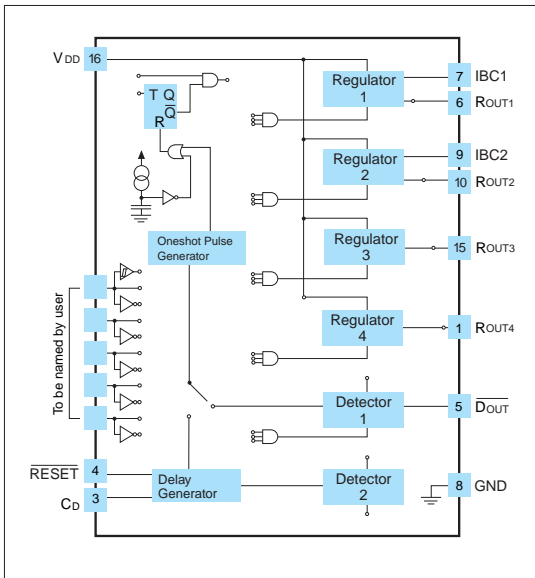
- ultra-low supply current
- broad operating voltage range .....1.5V to 10.0V
- high accuracy output voltage and detector threshold .....±2.5%
- stepwise setting with a step of 0.1V of output voltage and detector threshold is possible
- low temperature drift coefficient of output voltage and detector threshold .....TYP. ±100ppm/°C
- small dropout voltage.....(Regulator 1,2, I<sub>OUT</sub>=80mA)
- small package .....RS5VE0××× .....16 pin SOP (0.8 mm pitch)  
RV5VE0××× .....16 pin SSOP (0.65 mm pitch)
- direct connection to CPU by built-in level shifter

### Block Diagrams

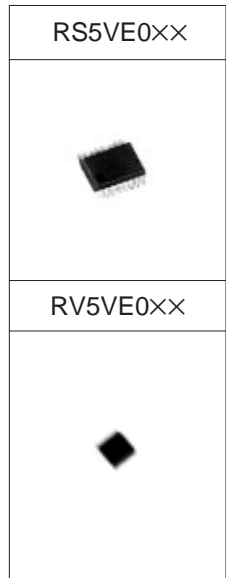
#### • R×5VE001×



#### • R×5VE0××× (optional mask version)

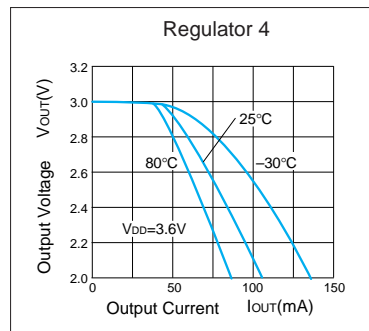
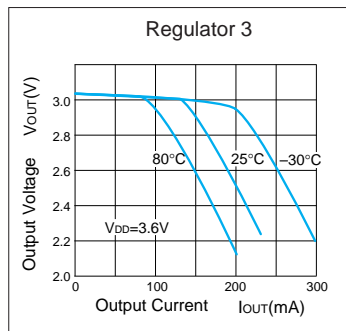
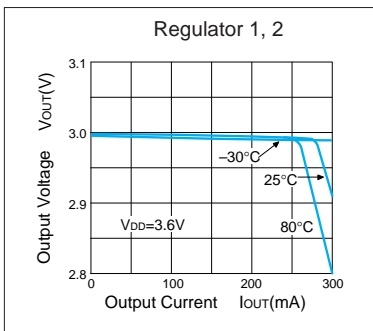


### Packages



### Typical Output Characteristics

#### R×5VE001C



### Applications

- power source system for hand-held communication devices such as cellular phones and cordless telephones
- power source system for battery-powered appliances

# RV5VG×××C Series

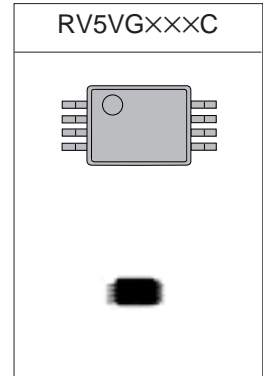
## Rechargeable Lithium-ion Cell Protector

RV5VG×××C series are rechargeable Lithium-ion battery protectors. These ICs consist of two or four voltage detectors, hysteresis circuit, voltage reference unit, logic circuit, short protection circuit and a detect circuit for connection to charger. Comes in two models; RV5VG1××C (for 1 cell) and RV5VG2××C (for 2 cell, underdevelopment). Available in 8pin SOP package (0.65mm pitch).

### Features (RV5VG1××C)

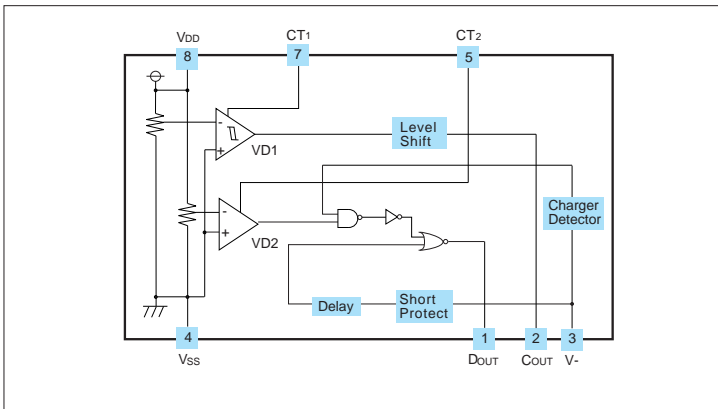
- low supply current .....TYP. 2.3μA
- low standby current .....TYP. 0.2μA (detecting over-discharge)
- high accuracy over-charge detector threshold .....TYP. ±50mV
- high accuracy over-discharge detector threshold .....TYP. ±2.5%
- stepwise setting with a step of 0.05V in the range of 4.0V to 4.5V of over-charge detector threshold is possible
- stepwise setting with a step of 0.05V in the range of 2.0V to 3.0V of over-discharge detector threshold is possible
- short protection circuit built-in
- stepwise setting with a step of 0.05V in the range of 0.1V to 0.4V of short detection voltage is possible
- sensing delay of over-charge .....time delay 43ms (C=1000pF, V<sub>DD</sub>=4.3V)
- sensing delay of over-discharge .....time delay 24ms (C=1000pF, V<sub>DD</sub>=2.4V)
- output type .....CMOS
- small package .....8 pin SOP (0.65mm pitch)

### Package

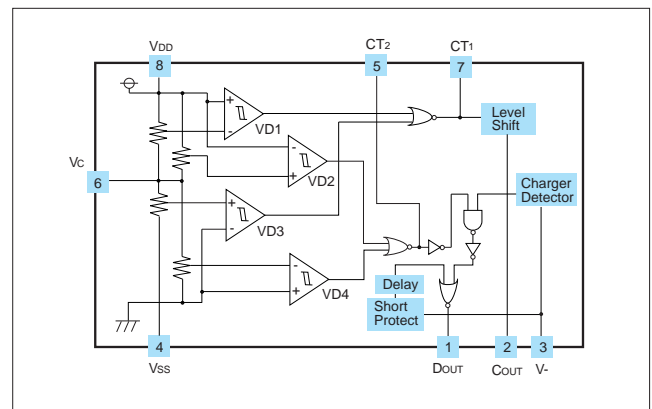


### Block Diagrams

#### • RV5VG1××C

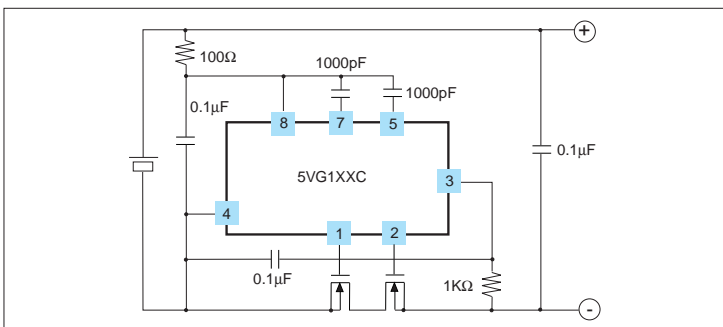


#### • RV5VG2××C <sup>\*underdevelopment</sup>

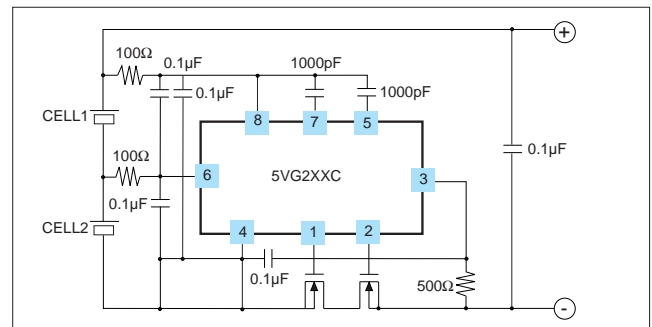


### Typical Circuit Configurations

#### • RV5VG1××C



#### • RV5VG2××C <sup>\*underdevelopment</sup>



### Applications

- li-ion cell protectors for power pack
- high precision protectors for cellular phones, camcorders and any other gadgets using Li-ion cell

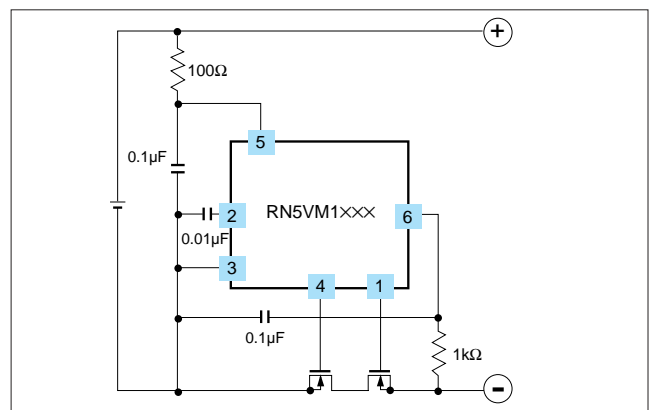
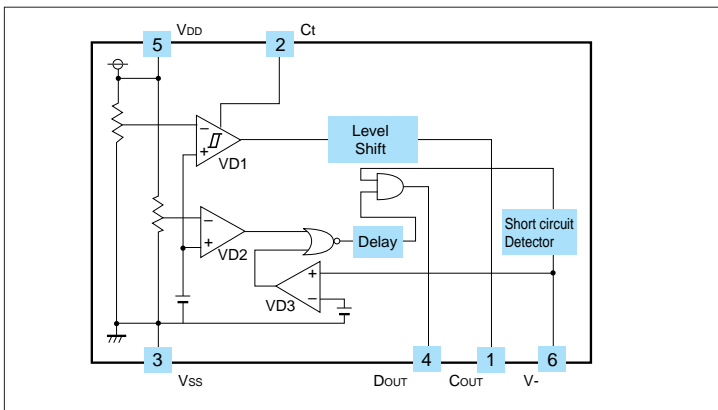
# RN5VM1xxC/D Series Li-Ion Battery Protector

The RN5VM series are protection ICs for over-charge/discharge and short of rechargeable one-cell Lithium-ion (Li+) batteries. Each model consists of three voltage detectors, a voltage reference unit, a hysteresis circuit, delay circuit and a short circuit protector. Comes in two models : drawing load current is allowable (xxC)/not allowable (xxD) after detecting over-charge.

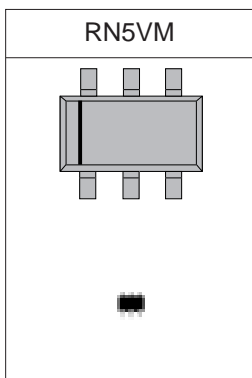
**Features**

- low supply current .....TYP. 3.0μA
- low standby current (after detecting over-discharge) .....TYP. 0.3μA
- high withstand voltage .....absolute maximum ratings 28V (V<sub>DD</sub>-V<sub>-</sub>)
- high accuracy detector threshold
  - over-charge detector .....±50mV
  - over-discharge detector .....±2.5%
- variety of detector threshold
  - over-charge detector threshold .....4.0V to 4.4V/step of 0.01V
  - over-discharge detector threshold .....2.0V to 3.0V/step of 0.05V
  - excess current .....0.05V to 0.4V/step of 0.05V
- built-in protection circuit .....excess current trip/short circuit protector
- output delay of over-charge .....time delay at C3= 0.01μF and V<sub>DD</sub>=4.3V   75ms for RN5VM111x
- ultra small package .....SOT-23-6

**Block Diagrams**



**Package**



**Applications**

- over-charge/over-discharge protection for Li+ one-cell pack
- high precision protectors for cell-phones and any other gadgets using on board Li+ one-cell battery

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June 1995



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