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Power Supply Devices

'05-6

SANYO Electric Co., Ltd. Semiconductor Company

TOKYO OFFICE
Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN
Telephone: 81-(0)3-3837-6339, 6340, 6342, Facsimile: 81-(0)3-3837-6377

●SANYO Electric Co.,Ltd. Semiconductor Company Homepage
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Power Supply IC

From Analog to Digital
SANYO's multifunction regulator IC series
and TR series support various electronic equipment
with advanced functions and high reliability to ensure
that customers catch the latest next-generation products.
In addition, "New Charge Pump" and "ISB®"
technologies, based on new technology developed
originally by SANYO, realize further
miniaturization in product size.

CONTENTS

ISB is a registered trademark of SANYO Electric Co., Ltd.

**Recently electronic equipment has been subject to various demands.
These demands range from stable operation at low input voltages, more compact and highly efficient power systems and low power consumption for products such as cellular phones, to lower power voltages and higher efficiency for the new millennium of digital home appliances, and even low standby power from the viewpoint of energy conservation and advanced technology for compliance with high frequency radiation standards, etc.
SANYO strives to swiftly and directly catch these customer needs, and to develop ICs from a system set base perspective with emphasis on the development of a wide range of general-purpose products.**

**SANYO has developed two major new technologies for specific fields. The first of these is called the New Charge Pump, and the second is called ISB®.
These module technologies make use of original SANYO substrate and mounting technologies to realize ultrathin, compact packages.
This technology makes it possible to provide the desired circuit blocks in a short period of time.
In addition, this technology also allows SANYO semiconductors to provide a wide range of services that match customer needs, such as TR groups characterized by the three terms, "too small to be seen", "easy-to-use" and "intelligent."**

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■ All products described in this catalog contain developed products or products that are diverted from general types.
In accordance with standard of quality management system ISO/TS16949 for automotive industry, there is a case where all demanded articles couldnÅft be supported, so please confirm to the salesman of our company at every order.

New Technology 1

more powerful
more beautiful

New Charge Pump Circuit

New Charge-Pump

Utilizing every last drop of battery and cutting power consumption are the perennial twin issues in the development of mobile electronic devices. Now we find ourselves in the megapixel era, where those issues are more pressing than ever. With camera-equipped cellular phones sporting charge coupled devices (CCDs) beyond the million pixel level, mobile devices are on the verge of a huge transformation. And to make that leap, they need new power.
To provide that power, SANYO offers its unique new charge pump circuit. It's a low noise circuit that does not use coils, and that means a charge pump circuit that does not degrade image quality. Plus it can maintain over 90% efficiency despite a voltage step-up factor of three or higher. This new charge pump circuit, the world's first to deliver such outstanding performance, is already at work powering mobile devices —— a paradigm shift on the move.

CONTENTS

1 Tactics for Stepping Up Voltage

The Old Way: A Switching Regulator

Requires coils

High noise level

Let's take a look at the methods that have been used to step up voltage so far. Think about the problem as the need to haul water uphill, to increase water pressure.
The first method is to catapult it up in one go.
That's simple, and does get the water up there.
But there is no way to prevent the considerable noise it generates and the headaches that causes about degradation of image quality, for example.

Switching-
Regulator

2 Tactics for Stepping Up Voltage

The Old Way: Switched Capacitor

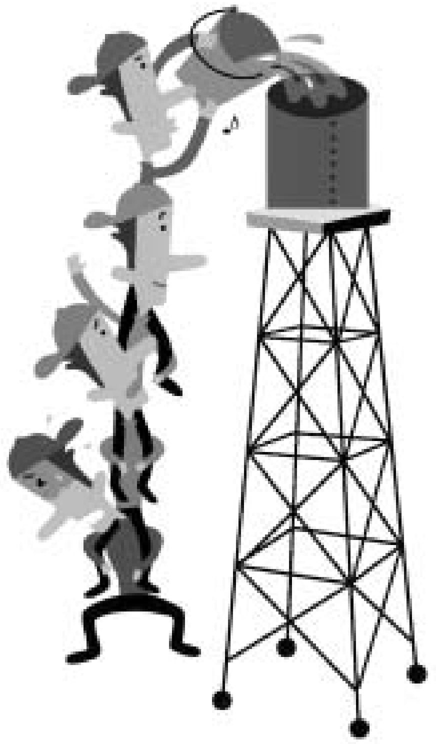
No coils

Low noise level

Requires muscleman (high voltage transistor) on the bottom of the pyramid

In the next method, players carrying the bucket of water keep climbing higher and higher on the shoulders of others.
That eliminates worries about noise, but imposes a huge burden on the player at the bottom. What it takes to stand up under that strain is serious muscle:
a high voltage transistor.
But using one entails high impedance, which literally impedes the flow of current.

Switched-
Capacitor



3 Tactics for Stepping Up Voltage

Solving the problems posed by the old methods

New Charge Pump

No coils

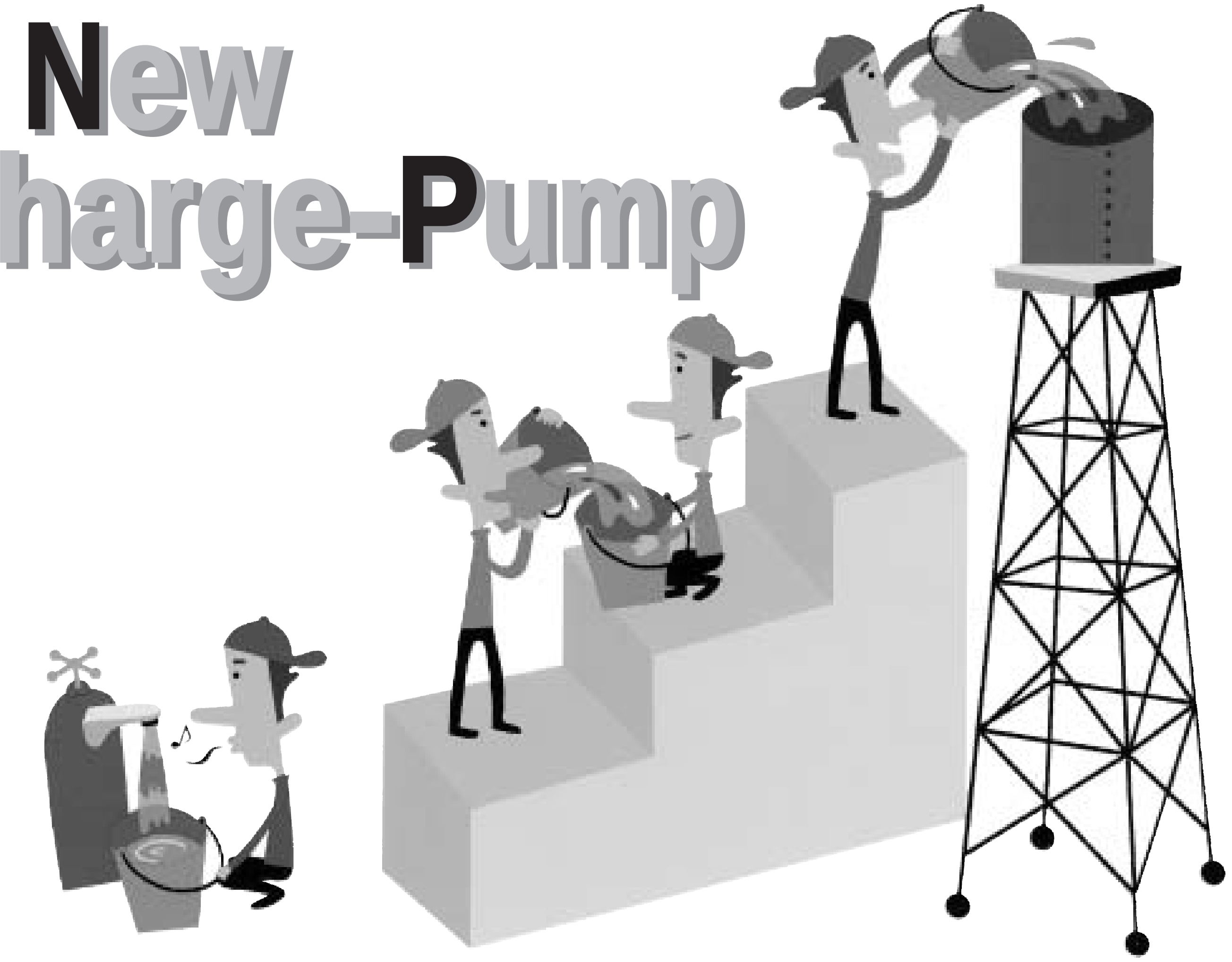
Low noise level

All players of equal strength (low voltage transistors)

And now we come to the newly developed charge pump circuit.
One player draws water, then lifts it up one step and pours it into the next higher bucket.
The same lift and pour actions are performed by each of the players, so that there is no extra burden on any one of them.
That means there is no need for a high voltage transistor somewhere in the circuit, and no extra impedance, so that a large current can flow. And, of course, only a few drops of water are spilled ----- it's very efficient.
Actually, in conventional charge pump circuits, the higher you step up, the larger the surface area of the step and the more effort needed to carry the bucket (that is, a higher voltage transistor is needed). That made that approach problematic for use in, for example, CCD power supplies. We found a solution that gets around that problem, thanks to some circuitry wizardry, and the result is our new charge pump circuit.

With the older method, it was a strain to haul the water handed up from the step below. Water often spilled, so that efficiency sank as the water was hauled higher. Our new method is designed to keep such spillage to an utter minimum.

New
Charge-Pump



Development Specification Proposal for Charge Pump Power Supply TEG
&
the Instruction Manual of X145 Evaluation Board

1 Overview

The X145 Evaluation Board is a board for the charge pump TEG X145.

2 Features

- Input voltage range 3.2V to 5.5V internally regulated to 3V.
- Dual outputs positive and negative (Two charge pump channels).
- Charge pump boost VH channel 6X input voltage VH=+15V (5mA average current).
- Charge pump boost inverting VL channel –3X input voltage VL=-8V (10mA average current).
- Built in regulator for DSP applications 2.5V (45mA average current).
- Internal / external oscillator is selectable
  SELECT = VDD Internal oscillator
  SELECT = VSS External oscillator. External oscillator is fed to CLK pin and the input range is from VDD to VSS.
- Built-in soft start function thereby reducing of in rush current once the chip is activated through STBY pin.
- Built-in short circuit protection of the charge pump output circuit.

3 Case Outline

VQFN48

4 Absolute Maximum Ratings at VSS=0V.

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	VBAT max		5.5	V
Operating temperature	Topr		–20 to 80	deg.
Storage temperature	Tstg		–40 to 125	deg.

5 Recommended Operating Conditions at VSS=0V.

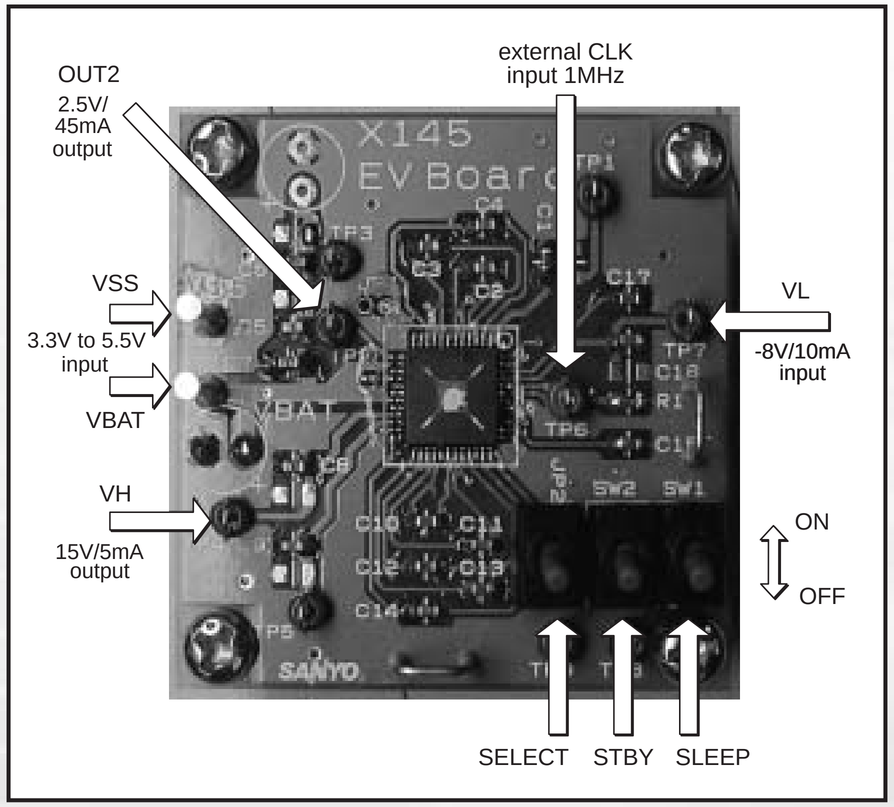
Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	VBAT		3.2 to 5.5	V

6 Electrical Characteristics

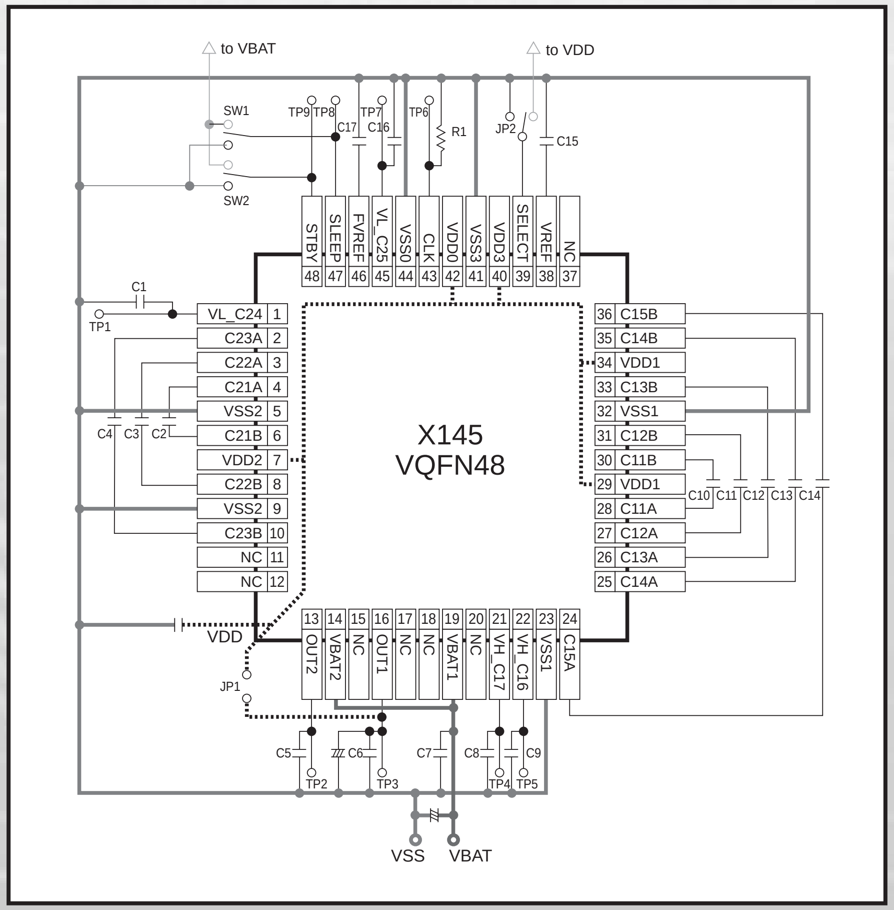
(Unless otherwise specified., VBATT=3.2V,VSS=0V,CLK=1MHz and Ta=25deg.)

Parameter	Symbol	Conditions	min	typ	max	Unit
Output voltage	VH			15		V
	VL			–8		V
	OUT1	Regulator only for input of charge pump		3		V
	OUT2			2.5		V
Maximum output current	IH_ave	Regulator output of 15V			5	mA
	IL_ave	Regulator output of –8V	–10			mA
	IO2_ave	Regulator output of 2.5V			45	mA
Electric power efficiency	Peff	2 channels charge pump output (include regulator)				%
External CLK frequency	fck-ext			1		MHz
Internal CLK frequency	fck-ext			1		MHz

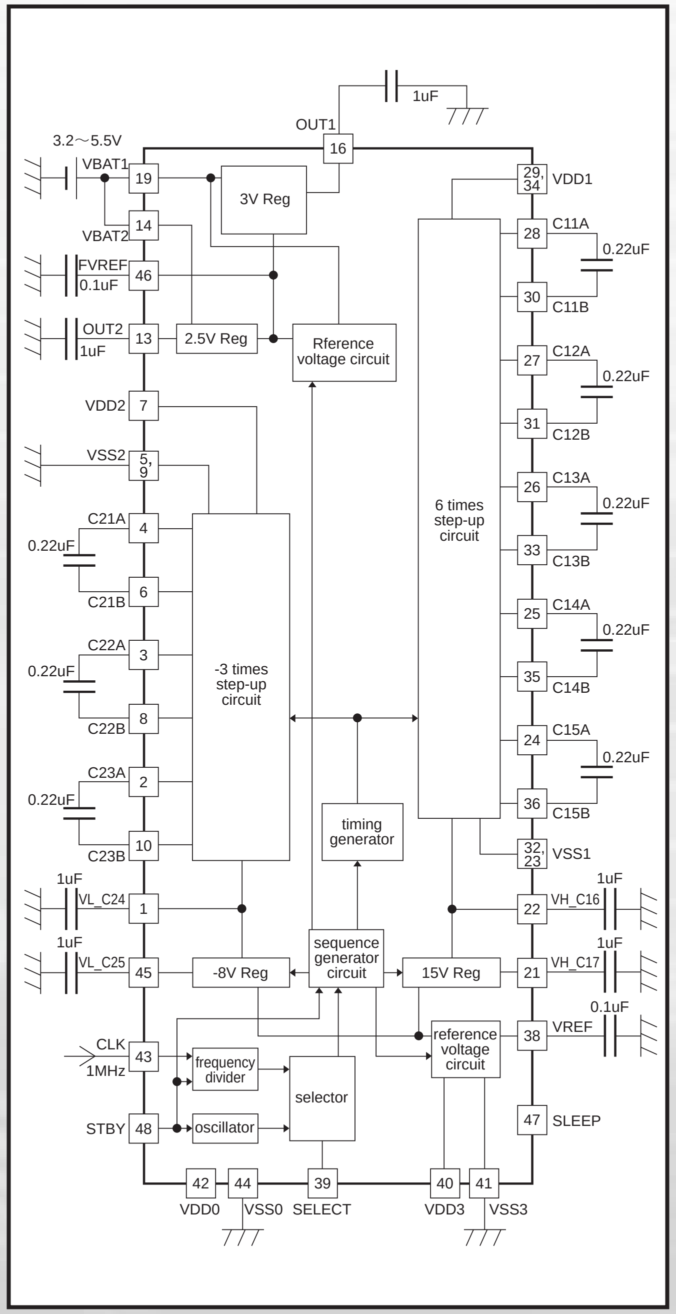
1 Completed Figure of Evaluation Board



2 Circuit Diagram of Evaluation Board

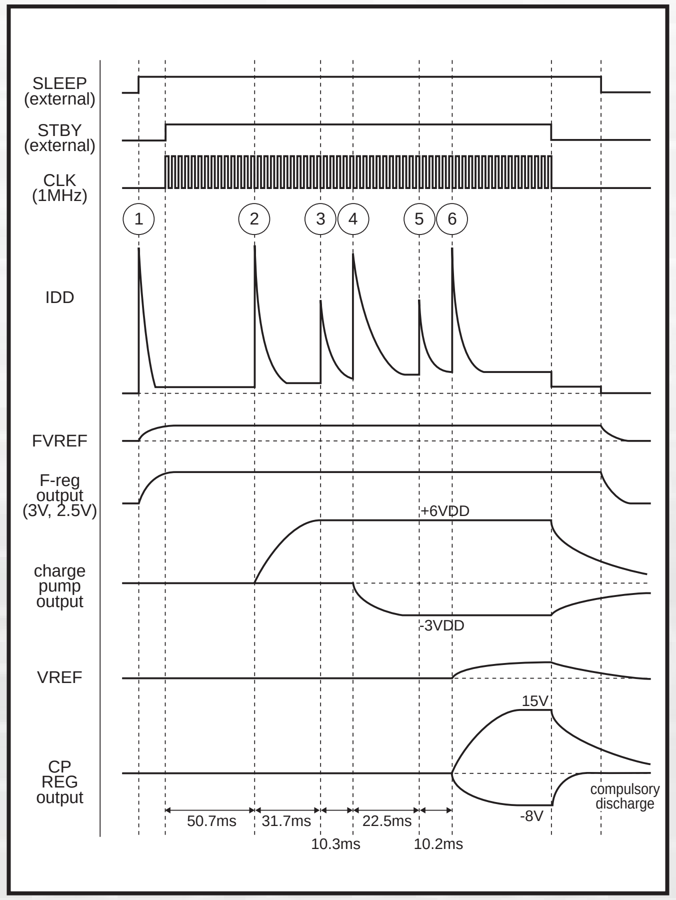


3 IC Block Diagram



Note : OUT1 I should be connected with VDD0,VDD1,VDD2 and VDD3.

4 Sequence of Rise and Fall

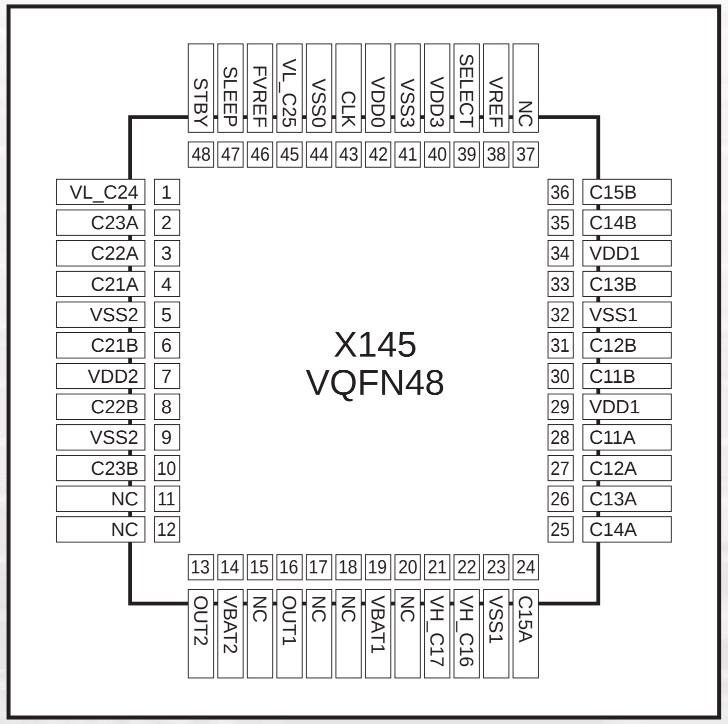


* Approximate waveform of IDD (in rush current) as shown in item 1 to 6.

1. Waveform was due to Charging of the filter capacitor of the front regulator .
2. Waveform was due to Charging of the pump-up capacitor by the plus side driver.
3. Waveform was due to Stabilizing of the output of the plus charge pump voltage.
4. Waveform was due to Charging of the pump-up capacitor by the negative side driver.
5. Waveform was due to Stabilizing of the output of the negative charge pump voltage.
6. Waveform was due to Charging of the filter capacitor of the output regulator.

The graph shows the timing (2-6) generated by the built-in sequence circuit. This waveform was measured with CLK=1MHz.

5 IC Pin Assignment



6 EV Board Parts List

NO.	REF	VALUE	RATING
1	C1	2∝F	16V
2	C2	0.22∝F	16V
3	C3	0.22∝F	16V
4	C4	0.22∝F	16V
5	C5	1∝F	6.3V
6	C6	1∝F	6.3V
7	C7	1∝F	6.3V
8	C8	1∝F	16V
9	C9	1∝F	25V
10	C10	0.22∝F	16V
11	C11	0.22∝F	16V
12	C12	0.22∝F	16V
13	C13	0.22∝F	16V
14	C14	0.22∝F	16V
15	C15	0.1∝F	50V
16	C16	1∝F	16V
17	C17	0.1∝F	50V
18	R1	51ohm	-
19	SW1		-
20	SW2		-

7 EV Board Pin Function

Pin Name	I/O	Function
VBAT		Battery voltage input 3.2V to 5.5V
VSS		GND pin
TP1		High voltage output (–3VDD)
TP2		Out2 regurator output 2.5V / 45mA average current
TP3		Out1 regulator output 3V / 130mA (only for internal IC)
TP4		VH High voltage output 15V / 5mA average current
TP5		High voltage output (6VDD)
TP6		External CLOCK input pin SELECT=Lo : external CLOCK, SELECT=VDD : internal oscillator)
TP7		VL High voltage output –8V / 10mA average current
TP8	I	SLEEP signal input pin Lo : Current dissipation in the sleeping mode is 1uA or less Hi : 2.5V and 3V generates.
TP9	I	STBY signal input pin Lo : Standby mode Hi : 15V and –8V generates

8 EV Board Switching and Jumper Function

SW1	Switch for change-over in SLEEP mode
SW2	Switch for change-over in STBY mode
JP1	Jumper code for connection in between OUT1 to VDD (When battery voltage is input directly)
JP2	Jumper code selection clock for the operation of the IC. Lo : external CLOCK input, High : internal oscillator

9 EV Board Operating Instructions

Set-up

1. Connect a power supply to the VBAT pin and the VSS pin.
2. Change SW1(SLEEP) and SW2(STBY) into the OFF state.
3. When CLOCK is input from external IC, connect to the TP6 pin (it is terminated by 51ohm).
4. When the oscillator built-in the IC is used, change JP2 into the ON state.

Start-up procedure

1. Apply electric power from the external power supply to the VBAT pin.
2. Change SW1(SLEEP) into the ON state. Thus, OUT1(3V) and OUT2(2.5V) will rise.
3. Input external CLOCK.(*3)
4. Change SW2 (STBY) into the ON state. Thus, VH(15V) and VL(-8V) will rise.
5. When the short protection circuit works, the output of VH and VL were latched to OFF state, Please re-start the circuit via STBY pin

   (*3) This procedure is not required when the oscillator built-in the IC was used.

Shut-down procedure

1. Change SW2(STBY) into the OFF state.
2. Turn off the external CLOCK.(*3)
3. Change SW1(SLEEP) into the OFF state.
4. Turn off the external power supply.

   (*3) This procedure is not required when the oscillator built-in the IC was used.

Focus on the Infinite Potential of Mobile Devices

Cellular phones with megapixel built-in cameras —image quality to rival stand-alone digital cameras. Add our new charge pump circuit, and you have a match made in heaven. When we, acting on a suggestion from a customer, set about developing a practical application of our highly efficient charge pump circuit as a CCD power supply in cellular phones, our new product's ship had come in.

SANYO's new charge pump circuits power more than cellular phones. Digital cameras, camcorders, PDAs — they are finding applications in a growing range of products. Now as we check out our charge pumps' characteristics and continue to improve them by listening to comments from customers in a wide range of fields, we will explore their further potential. We hope they'll help give birth to a new generation of mobile devices that soar beyond the limits of conventional thinking.

Technology Overview

New Charge Pump Power Supply Circuit

Higher efficiency than ever before and support for multi-stage step up.

The industry’s first “battery solution”

1 New high-efficiency n-stage step up charge pump circuit developed based on unique SANYO analog device technologies

SANYO has now, for the first time in the industry, developed a charge pump power supply circuit that maintains an efficiency of over 90% even at 3x and higher step-up ratios. This achievement was made possible by adopting unique SANYO-developed analog device technologies.

The demand for camera cell phones, digital cameras, PDAs, and other products that use CCD camera modules is increasing rapidly, and as the functionality of this equipment increases, the need for even lower power operation is growing stronger as well.
This new charge pump circuit, which is compact, efficient, and can generate high voltages, will be positioned as a strategic SANYO IP product, and SANYO is hopeful that this circuit will be adopted in a wide range of application areas.

Although the conventional charge pump circuit, which uses only capacitors and does not require inductors to increase the voltage, has superlative noise characteristics, its conversion efficiency results in large power losses making it problematic for use in low-power equipment such as portable digital equipment.

This new charge pump circuit that SANYO has now developed uses n capacitors for an n-stage step-up circuit, and uses charge transfer MOSFETs to charge those capacitors. This circuit provides the required supply voltages, both positive and negative, by repeating step up and charge transfer operations.

The step-up MOSFET gates are controlled by switching the arrangement of the capacitors, ground, and VDD with an appropriate timing (using clock signals). This results in the stepped-up charge being transferred to the adjacent capacitor. This allows stepped-up supply voltages to be generated with a high conversion efficiency (90 to 95%).

This new circuit, which generates minimal noise and can provide multiple supply voltages, is optimal for use in cell phone CCD camera chipsets.
Products using this technology have already been introduced to the market.

Since this circuit is noise free and is highly efficient in converting input power to the stepped-up voltages, circuit board shielding will not be required, even in application equipment that handles video. Furthermore, since this circuit will promote lower power, further miniaturization, and lower weight in application equipment, it increases design flexibility and can contribute to advances in end product styling and functionality. While the battery, which is a critical component in portable electronic equipment, must operate in harsh environments, the adoption of this new charge pump technology makes it possible to supply the various supply voltages required by the different modules used in this equipment.

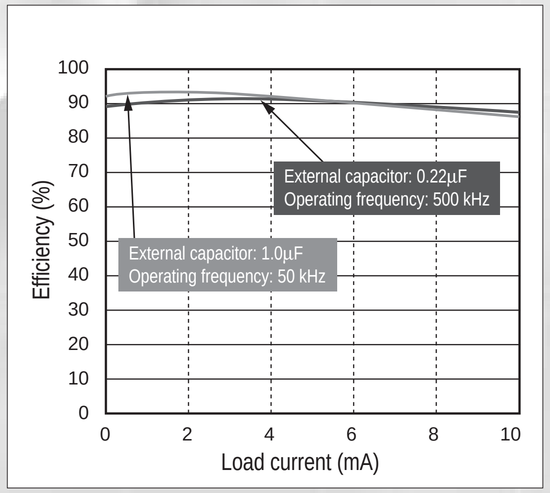
This new technology both promises and delivers solutions to the power supply needs in future portable electronic equipment, from megapixel class camera cell phones to camcorders and digital cameras, and can provide drive power for LCD and white LEDs as well. SANYO is also planning to expand the range of applications to include general-purpose and other products, and is aiming at introducing new products as they are developed.

2 Features and Specifications

<Application Examples>
SANYO can provide, as semi-custom ICs, optimal power supply solutions for applications such as CCD, OLED, low-temperature polysilicon LCD, white light-emitting diodes, RF circuits, and multi-voltage power supply system IC products.
SANYO is now developing ultraminiature package motor driver ICs and large-current charge pump power supplies optimal for the built-in power supplies in portable equipment, and is now looking into releasing general-purpose products using this technology.

- The adoption of an n-stage step-up circuit structure allows this circuit to handle applications that require multiple supply voltages.
- Supports high output current designs.
- High breakdown voltage MOSFETs are not used as the charge devices, but rather the circuit structure allows the use of n-channel MOSFETs for multiple purposes. This can achieve even lower impedance designs, and lower costs.
- The charge transfer MOSFET switching timing is controlled by a unique SANYO control technology. This prevents the occurrence of reverse currents and improves the power efficiency.
- Function for step up in 0.5VDD increments allows this technology to provide any and all supply voltages needed.
- Can provide both positive and negative voltages in fine step-up voltage increments in multi-voltage power supply applications. This makes this technology optimal for CCD drive.
  Step up increments: +0.5 x n x VDD
  −0.5 x n x VDD
  (Here, n is an integer.)
- Conversion efficiency: Achieves a high efficiency of 90 to 95%. (See figure 1.)
- Generates no noise and thus applications do not require circuit board shielding.
- Only thin-film capacitors required as external components.
- Since this technology allows operation at high frequencies (up to 1 MHz), smaller external capacitors can be used.
  Typical capacitor height: 1 mm (0.1μF), 1.25 mm (1μF)
- The development of a high breakdown voltage triple-well CMOS process allows this technology to reduce power consumption, improve insulating properties, and eliminate interfering noise.
  SANYO has acquired or filed applications for patents in Japan, the US, and other countries for various aspects of this unique high-efficiency charge pump power supply technology.

Figure 1 Efficiency Characteristics in +5 x Step-up Operation



3 New Charge Pump Circuit Principles of Operation (Three-stage step-up circuit)

A three-stage step-up circuit constructed using this new design uses a total of four capacitors, three for the individual stages and one smoothing capacitor, and four switching devices (MOSFETs). (Figure 2.)
The circuit iterates a sequence consisting of a charge cycle, in which charge is stored on a capacitor, and a charge transfer cycle, in which the charge is transferred to the adjacent capacitor. In this way, the charge is stepped up from C1 to C2, then from C2 to C3, then from C3 to the output smoothing capacitor C4.

4 Structure and Operation

Figure 3 shows the basic structure of a three-stage step-up type charge pump circuit. CLKB is the inverse of CLK, and CLK' and CLKB' are timing signals used to turn the charge transfer MOSFETs on or off at the point the clock signals change state. The LS circuits are level shifters, M1 to M4 are the MOSFETs that transfer the charge, C1 to C3 are the charge pump capacitors, and C4 is the smoothing capacitor. The charge generated from the VDD input as shown in figure 3 is transferred in order to C1, C2, C3, and C4, and is provided as the output voltage 4VDD.
The potentials at the pumping nodes V1, V2, and V3 are increased by Vdd at each stage by switching the negative side potential of the capacitors C1, C2, and C3 from 0 V to Vdd with the clock signal, and the output is thus stepped up to 4VDD. MOSFETs are used as the charge transferring elements (M1 to M4 in figure 3). Conventional charge pump circuits have the problem that the power efficiency is reduced since the internal impedance of the charge transfer MOSFETs is high. This circuit structure has the feature that the required breakdown voltage in these charge transfer MOSFETs is reduced from 4VDD to 2VDD, and as a result, the impedance can be reduced easily. This allows the circuit to provide higher currents and allows the conversion efficiency to be improved, thus resolving the problems with conventional charge pump circuits.

In this circuit, the voltage amplitude at each pumping node is limited to about VDD, and the charge transfer MOSFET drain-source voltage (VDS) has a maximum of 2VDD. This maximum voltage difference remains at 2VDD even if the number of step-up stages is increased.
The gate potentials are controlled by the level shifter circuits (LS1 to LS4). (Figure 4). The (a) diagram in figure 4 shows the noninverting circuit. When the input clock logic level is at the high level (VDD), the output level will be the high level, that is, the potential A. When the input clock logic level is at the low level (0 V), the output level will be the low level, that is, the potential B. The (b) diagram in figure 4 shows the inverting circuit.
The V1 to V3 potentials are stepped up an amount equal to the VDD supply voltage by the input clock (with levels of ground and VDD) frequency. (Figure 5)

Figure 2 Charge Transfer Example for Three Stage Step-up Operation

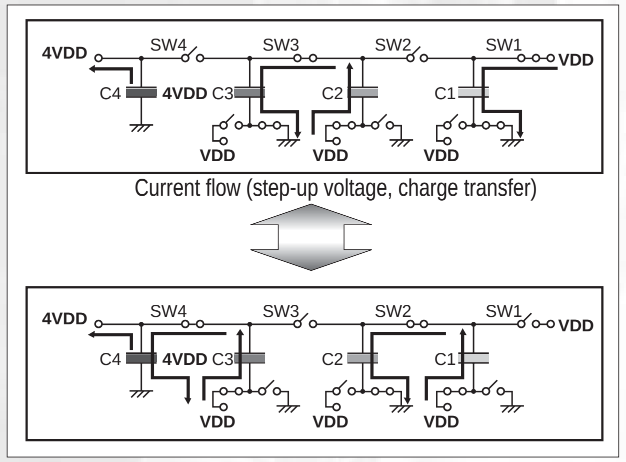


Figure 4 Level Shifter Circuit Block Diagrams

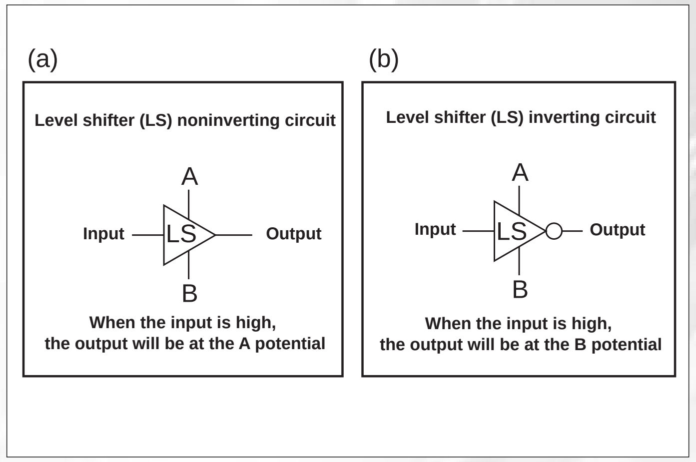


Figure 3 Three-Stage Charge Pump Circuit Basic Structure

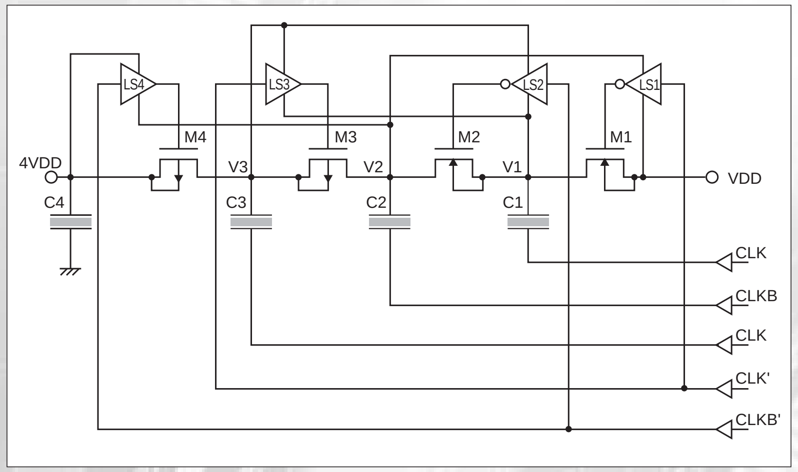
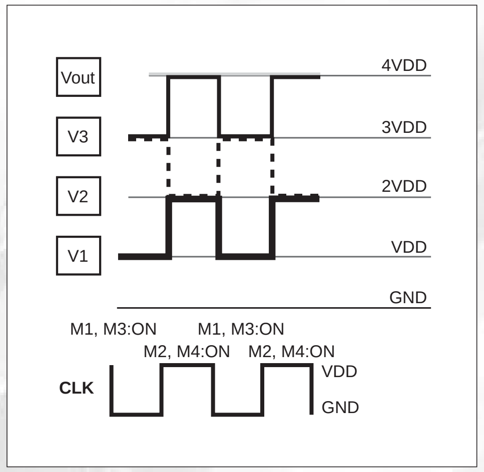


Figure 5 Input Clock and Voltages at Each Stage



5 Reverse Current Prevention

Conventional charge pump circuits have the problem that reverse currents flow from the output side during charge transfer MOSFET switching, resulting in reduced efficiency. These reverse currents occur due to slight shifts in the timing with which the charge transfer MOSFETs switch. In this newly-developed circuit, the operating timing of the clock rise and fall are adjusted and the timing is controlled so that all are off when the charge transfer MOSFETs switch. By setting the timing so that the clocks CLK and CLKB that drive the negative side of the capacitors to change at that point, the clocks that turn on the charge transfer MOSFETs are delayed relative to the timing with which the pumping nodes are switched on. This reliably prevents reverse currents from flowing and prevents power conversion loss.

6 0.5VDD Increment Step-up Function

In this newly-developed charge pump circuit, the capacitors used as the load at each stage have a split structure in which two capacitors with the same capacitance can be connected either in serial or in parallel using three switches. This allows this circuit to provide supply voltages with the fine voltage increment of 0.5VDD, in particular 2VDD, 2.5VDD, 3VDD, and 3.5VDD. (Figure 6)

7 High Step-up Efficiency

Figure 7 presents the step-up efficiency of a ±3x step-up charge pump circuit with external capacitances of under 1∝F and a clock frequency of 1 MHz.

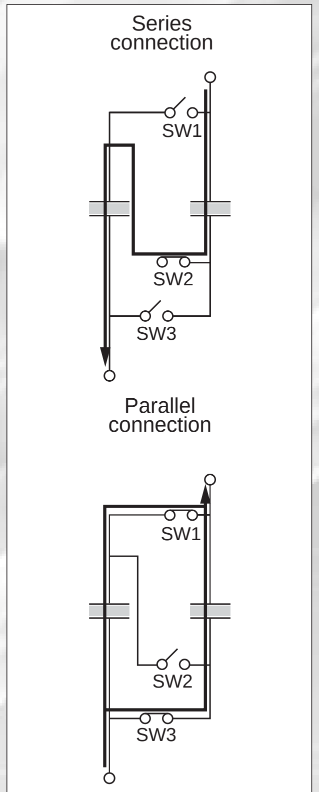
The results of measuring the output voltage vs. load current characteristics show that this circuit can generate output voltages equivalent to ±3VDD with an input supply voltage of 3.3 V.

The results of measuring the step-up efficiency vs. load current characteristics show that this circuit achieves the high step-up power efficiency of over 80% when the load current is 40 mA and a power efficiency of over 75% when the load current is between 20 mA and 80 mA.

Although the efficiency drops somewhat to 72% when the load current is 100 mA, this could be improved by techniques such as reducing IC internal impedances by modifying the size of the transistors.

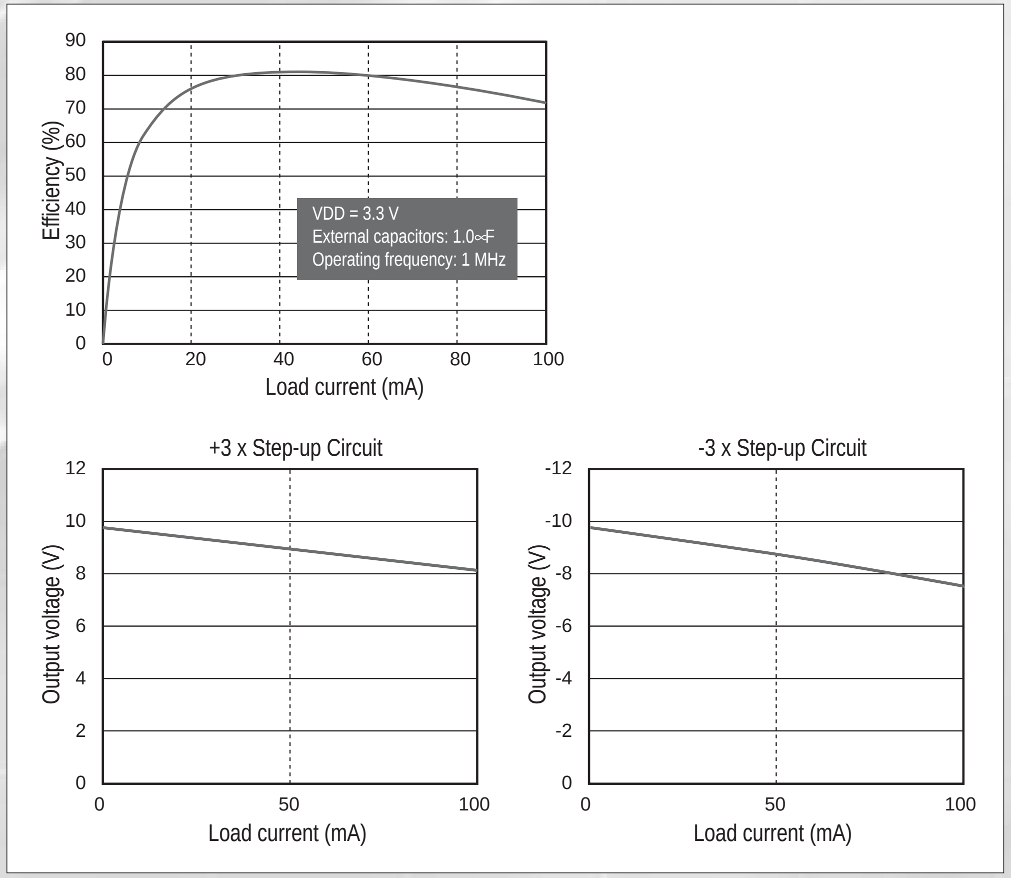
SANYO is aware of the wide range of functions that are expected to be included in the next generation of camera cell phones, functions such as autofocus systems, zoom lenses, and mechanical shutters, and is therefore working on developing products that provide even higher efficiency and higher currents based on this new technology. At the same time SANYO is also working to expand the range of applications for this technology to new fields.

Figure 6 Incremental Step-up Function Equivalent Circuit



Switching between serial connection and parallel connection makes providing step-up in increments of 0.5VDD possible.

Figure 7 3 x Step-up Circuit Output Characteristics (VDD = 3.3 V, operating frequency = 1 MHz. Using 1.0∝F external capacitors.)



New Technology 2

Super Thin

Miniaturization

High Density

High-density, super-thin modules

ISB® Integrated System in Board

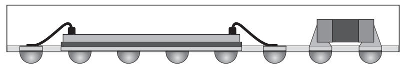
ISB® is a type of SiP (System in Package), and is a module technology that can realize high-density, super-thin products through the use of original SANYO substrate and mounting technologies.
The ISB® lineup includes three different processes (ISB-Solo®, ISB-Duo®, and ISB-Quad®) for various applications.
These processes enable the creation of ISB® modules in a short period of time by assembling customer-specified circuit blocks as well as standard products using the optimum process.

ISB® process lineup

ISB-Solo®

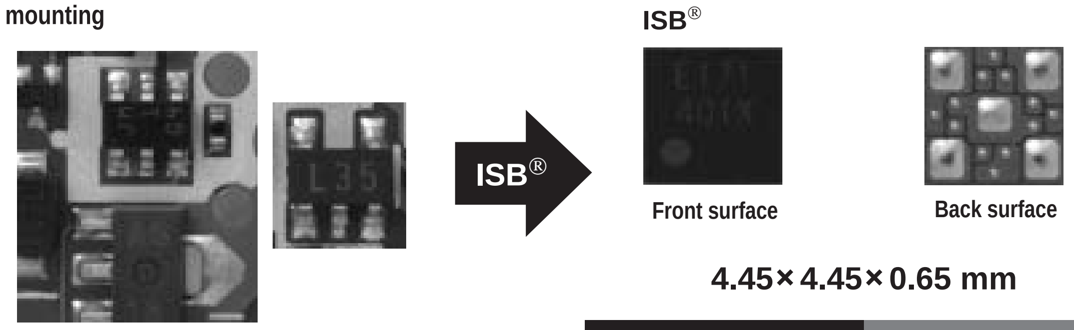
- A thickness of only 0.45 mm (0.65 mm if resistors are included) offers superlative thermal dissipation and makes it possible to shorten the development TAT.
- Optimum for creating SiP from small-scale blocks that include semi-power portions.

■ **Example assembly structure**



■ **Example application (cellular phone charger circuit block)**

Conventional mounting



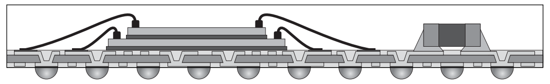
4.45×4.45×0.65 mm

Mounting area 80% reduction

ISB-Duo®

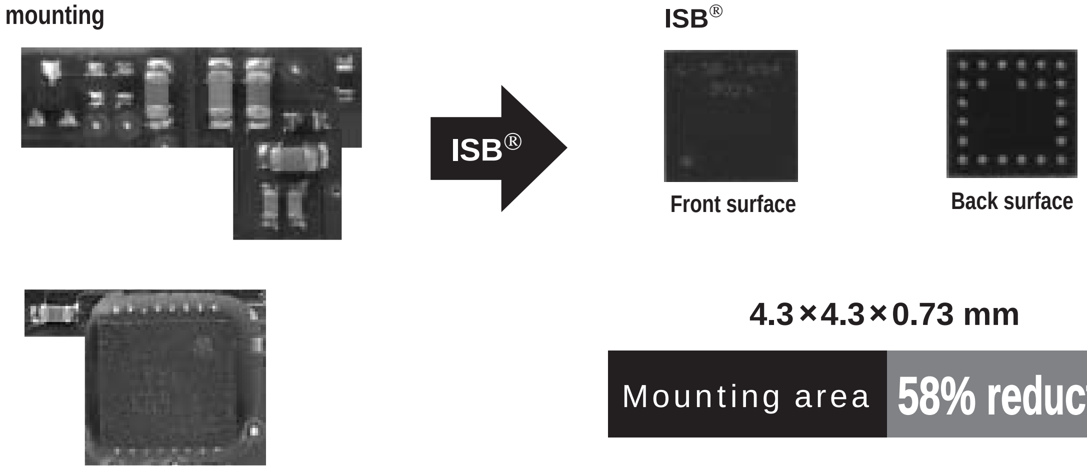
- Employs an originally developed 0.2 mm thick high-density substrate (2-layer wiring). (Line/Space: 40 µm/40 µm at a copper thickness of 25 µm, Via/Via Land: 100 µm/150 µmø)
- A package thickness of only 0.53 mm (0.73 mm if resistors are included) allows high-density mounting.
- Optimum for creating SiP from high-frequency blocks up to 10 GHz, blocks that require superlative performance and EMC measures based on the component layout and wiring, and blocks that require partial high-density mounting, etc.

■ **Example assembly structure**



■ **Example application (clock detector block)**

Conventional mounting



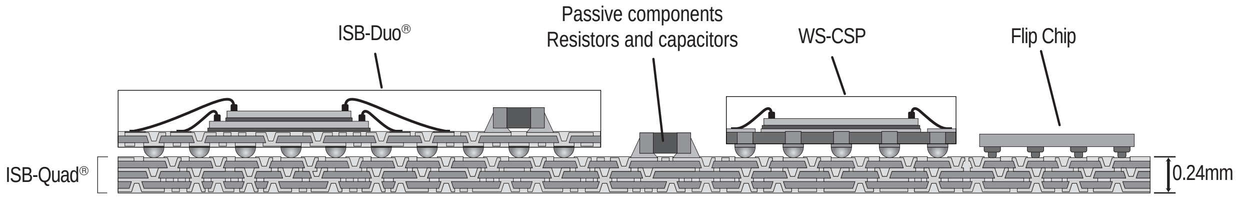
4.3×4.3×0.73 mm

Mounting area 58% reduction

ISB-Quad®

- Employs an originally developed 0.24 mm thick high-density substrate (4-layer wiring).
- A package thickness of only 0.6 mm allows super-thin, high-density mounting.
- Optimum for creating SiP from high-frequency blocks up to 10 GHz, blocks that require superlative performance and EMC measures based on the component layout and wiring, and blocks that require high-density subsystem modules.
- Chip on Board type

■ **Example assembly structure**



ISB, ISB-Solo, ISB-Duo and ISB-Quad are registered trademarks of SANYO Electric Co., Ltd.

ISB® Applied Products (Standard Products)

Super-thin, Compact 1-channel and 2-channel DC/DC Converter Power Supply

In addition to assembling ISB® devices from circuit blocks requested by customers, SANYO is also enhancing its lineup of standard ISB® products. Some examples of these are introduced below.

■ SR series

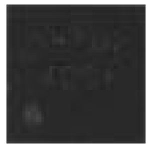
Step-up DC/DC controller ICs, n-channel power MOSFET and Schottky barrier diode devices can be combined into modules. simply by connecting an external voltage setting resistor, coil and capacitor.
This makes it possible to easily configure a switching step-up power supply

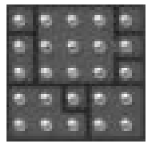
■ Comparison of discrete mounting and ISB®

Conventional mounting

ISB®

ISB®

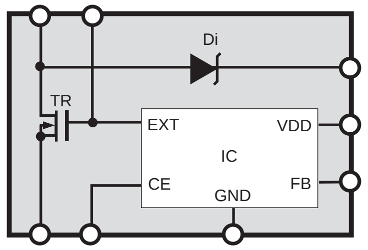

Front surface

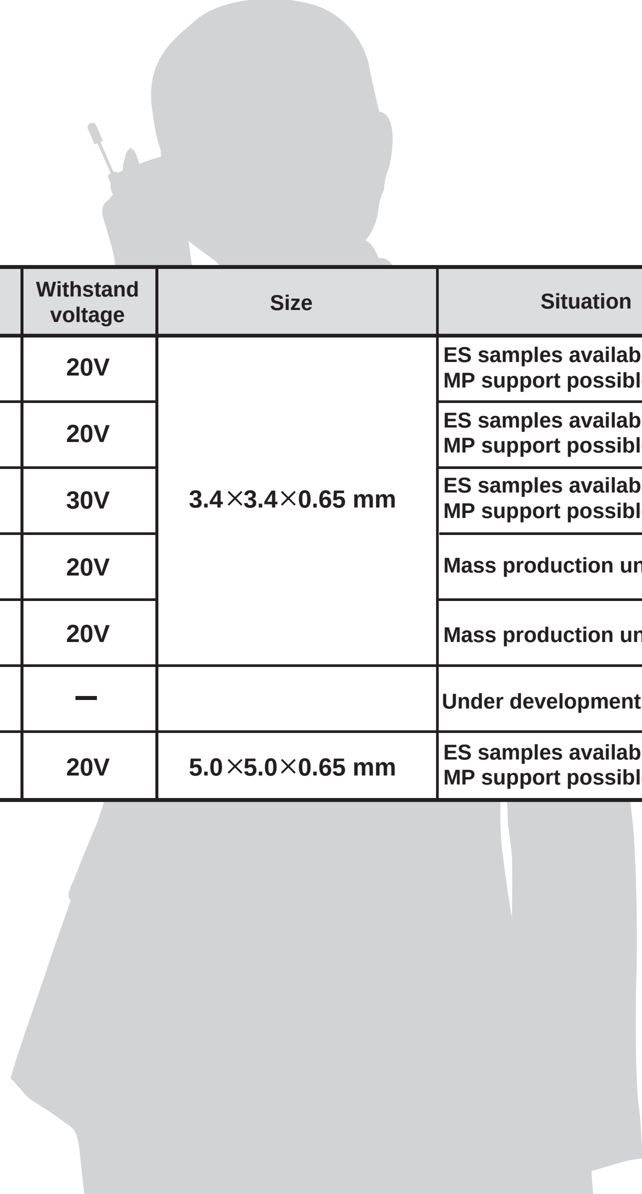

Back surface

4.4×3.4×0.65 mm

Mounting area 35% reduction

■ Block diagram (SR10010)





■ Series configuration

Type No.	Number of channels	Type	Oscillation frequency	Withstand voltage	Size	Situation
SR10010	1ch	Step-up type	180kHz	20V	3.4×3.4×0.65 mm	ES samples available, MP support possible
SR10020			300kHz	20V		ES samples available, MP support possible
SR10030			180kHz	30V		ES samples available, MP support possible
SR10110			100kHz	20V		Mass production underway
SR10210			100kHz	20V		Mass production underway
SR103XX		Step-down type	—	—		Under development
SR20010	2ch	±power supply type	180kHz	20V	5.0×5.0×0.65 mm	ES samples available, MP support possible

ISB is a registered trademark of SANYO Electric Co., Ltd.

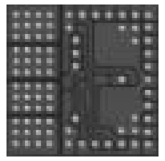
Two-Phase Full and Half Stepping Motor Driver

■ STK672-570

Unipolar constant-current chopper type (external excitation PWM) with built-in phase signal distributor

■ Appearance


Front surface


Back surface

7.5×7.5×0.65 mm

■ Comparison with SANYO hybrid IC

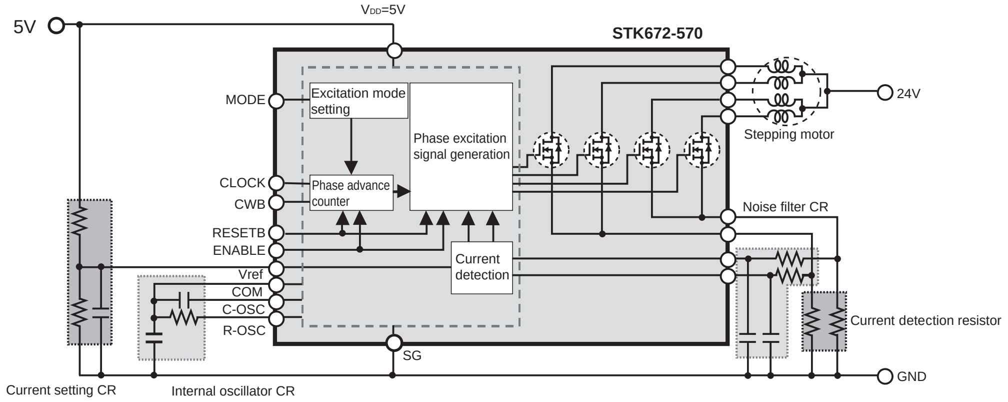
Mounting area 90% reduction

Can be mounted simultaneously with SMD components
⇒ Reduced assembly process steps

Volume 98% reduction

Low mounted height
⇒ Allows a reduction in set thickness

■ Block diagram



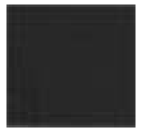
■ Specifications

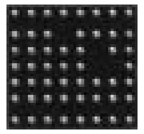
Type No.	Supply voltage 1	Supply voltage 2	Maximum output current	Size	Situation
STK672-570	10 to 44V	5V ±5%	1.0A	7.5×7.5×0.65 mm	ES samples available

Power Amplifier Module for 2.4 GHz Band Wireless LAN

Incorporating W-LAN functions is essential to support the rapidly evolving ubiquitous society.
ISB® makes it possible to combine a power amplifier, matching circuits and an antenna (diversity) switch into a compact, super-thin PA module.

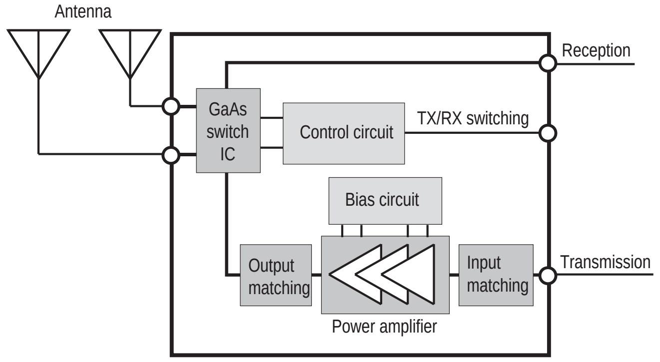
■ Appearance


Front surface


Back surface

4.8×4.6×0.73 mm

■ Block diagram



Products by Application

Ⓝ.......... New product

Ⓓ.......... Under development

Digital Camera Use

LA5627W ☞ P 32
LA5646T
LA5649T ☞ P 30
LA5660M ☞ P 27
LA5662M ☞ P 28
LA5679T ☞ P 31
LA5683T ☞ P 33
Ⓝ LA5680T ☞ P 34

Battery Charger Use

LA5614M ☞ P 57
LA5615M ☞ P 58
LA5619M ☞ P 58
LA5621M
LA5636M ☞ P 56
Ⓝ LA5645M

On-Demand Water Heater Use

LA5693D/M ☞ P 54
LA5695M ☞ P 55

VCR Use

Ⓓ LV5038M ☞ P 44
LA5611
LA5612
LA5613 ☞ P 50
LA5634
LA5644

Game Machine Use

LA5648 ☞ P 45
LA5660M ☞ P 27
LA5662M ☞ P 28
Ⓝ LV5040V ☞ P 37
Ⓓ LV5042V ☞ P 39
Ⓓ LV5043V ☞ P 40
Ⓓ LV5047V ☞ P 38

Cellular Phone Use

Ⓝ LV5105FN ☞ P 43

LCD TV Use

Ⓝ LA5771MP/72MP ☞ P 35
Ⓝ LA5751/52/53/54 ☞ P 36
Ⓝ LA5751MP/52MP/54MP ☞ P 36

Car Audio Use

LA5624H ☞ P 48
LA5657H ☞ P 47

Mini-Component Audio Use

LA5601 ☞ P 49
LA5602
LA5616
LA5617
LA5618 ☞ P 51
LA5620
LA5632
LA5643
LA5678H ☞ P 52

Notebook Personal Computer Use

LA5660M ☞ P 27
LA5662M ☞ P 28
LA5663V ☞ P 46
LA5664M ☞ P 29
(USB scanner)

Discrete Devices for Power Supplies ☞ P 63 to 72

Power Supply IC Lineup

SANYO Regulators

◎.......... New product ✻.......... Under development

Switching Regulators

Type	Input voltage	Output voltage	Channels	Power stages	Package	Type No.	Notes	P
Step up	1.8V to 14V	Programmable externally	1ch	External (NPN or NMOS)	MFP8 (225mil)	**LA5660M**		27
Step down	1.8V to 11V	Programmable externally	1ch	External (PNP or PMOS)	MFP8 (225mil)	**LA5662M**		28
	1.8V to 11V	Programmable externally	3ch	External (PNP)	TSSOP36 (275mil)	**LA5646T**		
	1.8V to 11V	Programmable externally	3ch	External (PNP)	TSSOP36 (275mil)	**LA5649T**		30
	1.8V(1.2V) to 11V	Programmable externally	4ch	External (PNP)	SQFP48 (7 x 7)	**LA5627W**	Can operate from 1.2 V when the subsidiary power supply is used.	32
	5.5V to 30V	3.3V / 3A	1ch	Built in	SMP5	◎**LA5771MP**		35
	7V to 30V	5V / 3A	1ch	Built in	SMP5	◎**LA5772MP**		35
	5.5V to 30V	3.3V / 3A	1ch	Built in	TO220-5H	◎**LA5751**		36
	7V to 30V	5V / 3A	1ch	Built in	TO220-5H	◎**LA5752**		36
	15V to 30V	12V / 3A	1ch	Built in	TO220-5H	◎**LA5753**		36
	5.5V to 28V	Variable	1ch	Built in	TO220-5H	◎**LA5754**		36
	5.5V to 30V	3.3V / 3A	1ch	Built in	SMP5	◎**LA5751MP**		36
	7V to 30V	5V / 3A	1ch	Built in	SMP5	◎**LA5752MP**		36
	15V to 30V	12V / 3A	1ch	Built in	SMP5	◎**LA5753MP**		36
	5.5V to 28V	Variable	1ch	Built in	SMP5	◎**LA5754MP**		36
Mixed step up /step down	1.8V to 11V	Programmable externally	3 channels (1 step-up and 2 step-down channels)	External (NPN,PNP or NMOS,PMOS)	TSSOP36 (275mil)	**LA5679T**		31
	1.8V to 8V	Programmable externally	4 channels (2 step-up and 2 step-down channels)	External (NPN,PNP or NMOS,PMOS)	TSSOP36 (275mil)	**LA5683T**		33
	1.5V to 12V	Programmable externally	6 channels (4 step-up and 2 step-down channels)	External (NPN,PNP or NMOS,PMOS)	TQFP48J (7 x 7)	◎**LA5680T**		34
Step up/ down	4V to 5.6V	5V/250mA	1ch	Built in	MFP14S (225mil)	**LA5664M**		29
Step up + lenear regurator	8.5V to 18V	Programmable externally	5ch	External (NPN or PMOS)	SSOP30 (275mil)	✻**LV5045V**		41
	1.5V to 4.4V 2V to 8.0V	2.5 V (step up / down) 2.8V / 3.9A (linear)	3ch	Built in	TSSOP24 (225mil)	**LV5051T**		42
Inverter voltage	4.5V to 23V	Programmable externally (current)	1ch	External	SSOP24 (275mil)	**LA5663V**		46

◎.......... New product ✻.......... Under development

Synchronous Rectification Switching Regulators

Type	Input voltage	Output voltage	Channels	Power stages	Package	Type No.	Notes	P
Step up	10V to 14V	Programmable externally	2ch	External (NMOS)	SSOP30 (275mil)	◎**LV5040V**		37
	4.5V to 36V	Programmable externally	2ch	External (NMOS)	SSOP30 (275mil)	✻**LV5042V**		39
	4.5V to 16V	Programmable externally	2ch	External (NMOS)	SSOP30 (275mil)	✻**LV5043V**		40
	5.5V to 18V	Programmable externally	1ch	External (NMOS)	SSOP16 (225mil)	✻**LV5047V**		38

Cellular Phone System Power Supplies

Type No.	Regulator output voltage(V) /current(mA)				Absolute maximum ratings		Package	Functions/Features	P
	1	2	3	4	Input voltage	Total power dissipation			
◎**LV5105FN**	2.8V/ 150mA	2.6V/ 100mA	2.85V/ 50mA	3V/ 50mA	5.9	0.44	VQFN48 (7 x 7)	Detection circuits, 3-color LED driver, white LED driver, and microphone bias output	43

Car Audio System Regulators

Type No.	Regulator output voltage(V) /current(mA)					Absolute maximum ratings		Package	Functions/Features			P
	1	2	3	4	5	Input voltage	Total power dissipation		On/off function	Reset output	Notes	
LA5657H	10V/ 2200mA	5V/ 1400mA	5V/ 30mA	8V/ 30mA	8V/ 200mA	24	2.01	HSOP28H (375mil)	○	○	•Low saturation-voltage 10 V/2.2 A and 5 V/1.4 A outputs can be implemented using external pnp transistors. •The on/off state of the IC can be controlled using the STBY and CCB signals. •Includes three built-in reset detection systems.	47
	5V/ 100mA	3.25V/ 100mA	SW/ 100mA	SW/ 250mA	OP-C/ 10mA							
	OP-C/ 10mA	OP-C/ 10mA	OP-C/ 10mA									

System Regulators

Type No.	Regulator output voltage(V) /current(mA)					Absolute maximum ratings		Package	Functions/Features			P
	1	2	3	4	5	Input voltage	Total power dissipation		On/off function	Reset output	Notes	
LA5601	5.2V/ 250mA	3.4V/ 10mA				15	1.0	DIP10S (300mil)	○	○	Built-in drivers	49
LA5602	5.0V/ 350mA					18	1.5	SIP7H				
LA5605	7.5V/ 500mA	9V/ 60mA	5V/ 10mA			24	2.0	SIP13H	○		Built-in AC standby and power detection functions	
LA5606N	15.7V/ 350mA	12V/ 200mA	9V/ 150mA	5V/ 500mA		35	4.3	SIP14H	○			
LA5609	14.5V/ 1200mA	9V/ 300mA	7.5V/ 800mA	5.05V/ 220mA	5V/ 220mA	24	3.5	SIP18H	○	○	Built-in mode switch, power control, and remote control standby functions	
	5V/ 100mA	8V/ 800mA	9V/ 60mA									
LA5611	9V/ Within ASO of external TR	5.05V/ 480mA	5.05V/ 240mA	5.7V/ 48mA		22	2.0	SIP13H	○		Built-in switching regulator control amplifier	
LA5612	14.5V/ 360mA	5.05V/ 420mA	5.05V/ 420mA			22	2.0	SIP13H	○		Two built-in control amplifiers	

Continued on next page

Power Supply IC Lineup

From preceding page

System Regulators

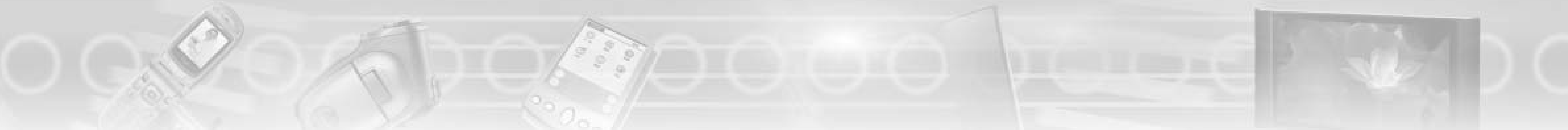
Type No.	Regulator output voltage(V) /current(mA)					Absolute maximum ratings		Package	Functions/Features			P
	1	2	3	4	5	Input voltage (V)	Total power dissipation (W)		On/off function	Reset output	Notes	
LA5613	5.1V/ 700mA	SW/ 300mA				14	1.7	SIP10F	○		Built-in 11.3V/0.3A ripple filter and switching regulator control amplifier	50
LA5616	5V/ 400mA	7V/ 1000mA				18	2.0	SIP10F	○	○	The 5 V regulator is a low dropout voltage circuit.	
LA5617	7.5V/ 1500mA	−7.5V/ −1500mA				±18	2.0	SIP10F	○		Positive and negative voltage tracking regulator	
LA5618	7.5V/ 1500mA	−7.5V/ −1500mA				±18	2.3	SIP12H	○		Positive and negative voltage tracking regulator	51
LA5620	3.3V/ 40mA	3.3V/ 150mA	5V/ 100mA	5V/ 1000mA		14	2.3	SIP12H		○	Power on/off detection circuit	
LA5624H	5V/ 50mA	10V/ Within ASO of external TR	8V/ 100mA	8V/ 30mA	8V/ 150mA	24	2.01	HSOP28HC (375mil)	○	○	A low saturation-voltage 10 V regulator can be implemented using an external pnp transistor. The on/off state of the IC can be controlled using the STBY pin and serial control data.	48
	8V/ 100mA	5V/ 100mA	5V/ 300mA	SW/ 100mA	SW/ 100mA							
	OP-C/ 10mA	OP-C/ 10mA	OP-C/ 10mA	OP-C/ 10mA								
LA5632	3.3V/ 60mA	3.3V/ 150mA	5V/ 1000mA	5V/ 100mA		14	2.3	SIP12H	○	○	Power on/off detection circuit	
LA5634	5.1V/ 1700mA	SW/ 500mA				14	1.7	SIP10F	○		V_{CC}1-1 V/0.5 A ripple filter switching regulator control amplifier built in	
LA5635H	5V/ 50mA	10V/ Within ASO of external TR	8V/ 200mA	8V/ 30mA	8V/ 150mA	24	2.01	HSOP28HC (375mil)	○	○	A low saturation-voltage 10 V regulator can be implemented using an external pnp transistor. The on/off state of the IC can be controlled using the STBY pin and serial control data.	
	8V/ 100mA	5V/ 100mA	5V/ 300mA	SW/ 100mA	SW/ 500mA							
	OP-C/ 10mA	OP-C/ 10mA	OP-C/ 10mA	OP-C/ 10mA								
LA5643	3.5V/ 150mA	5V/ 1000mA	5V/ 100mA			14	2.0	SIP13H		○		
LA5644	5.1V/ 1700mA	SW/ 500mA				14	1.7	SIP10F	○		V_{CC}1-1 V/0.5 A ripple filter switching regulator control amplifier built in	
LA5678H	3.0V/ 100mA	3.0V/ 50mA	3.3V/ 150mA	3.5V/ 50mA		9	0.79	HSOP28HC (375mil)	○		Built-in 1.5 channel forward/reverse motor driver The regulator output 1 can be switched from 3.0 to 3.4 V with a switch.	52

Power Supply ICs with Built-in Watchdog Timer Circuits

Type No.	Absolute maximum ratings		Package	Functions						P
	Input voltage (V)	Total power dissipation (W)		Reset logic output	Reset hold	5 V regulator control	Regulator output on/off control	Edge detection	Watchdog time typical (Ct = 2 ∝F)	
LA5690D	41	0.5	DIP8 (300mil)	Noninverted/ inverted		○		○	5ms	
LA5690S		0.5	SIP9							
LA5691D	41	0.5	DIP8 (300mil)	inverted		○	○	○	5ms	
LA5691S		0.5	SIP9							
LA5692D	41	0.5	DIP8 (300mil)	inverted	○	○		○	40ms	
LA5692S		0.5	SIP9							
LA5692M		0.37	MFP8 (225mil)							
LA5693D	41	0.5	DIP8 (300mil)	inverted	○	○			40ms	54
LA5693M		0.37	MFP8 (225mil)							
✻LA5694M	20	0.37	MFP8 (225mil)	inverted	○	○		○	40ms	

Dual Protection ICs

Type No.	Absolute maximum ratings		Package	Functions/Features	P
	Input voltage (V)	Total power dissipation (W)			
LA5695M	18	0.4	MFP14 (225mil)	•Built-in supply voltage abnormality detection circuit •Driver output with built-in output delay circuits •Allows control from 8 input pins.	55



Power Supply IC Lineup

◎ .... New product

Rechargeable Battery Charge Control ICs

Battery Type	Type No.	Absolute maximum ratings		Package	Functions/Features	P
		Input voltage (V)	Total power dissipation (W)			
Nicad, nickel-metal-hydride	**LA5614M**	9	0.25	MFP10S (225mil)	Charging voltage detection,switching between cycle and trickle charging,charge current is set with an external resistor.	57
Lead	**LA5615M**	15	0.7	MFP16FS (300mil)	Switching between cycle and trickle charging, voltage and current detection.	58
	LA5619M				Switching between cycle and trickle charging, voltage and current detection.	58
Lithium ion	**LA5621M**	11	0.32	MFP14 (225mil)	Current and voltage detection	
	LA5621V		0.25	SSOP16 (225mil)	Current and voltage detection, modified package version of the LA5621M	
Lithium ion, nickel-metal-hydride	◎ **LA5636M**	14.5	0.36	MFP10S (225mil)	High-accuracy reference current (92.5 ∝A ±2.7%)	56
Battery charger	◎ **LA5645M**	14.5	0.3	MFP8 (225mil)	High-precision reference voltage (1.5 V ±1 %), input offset voltage (2 mV max)	
	LA5645T		0.2	MSOP8 (150mil)	High-precision reference voltage (1.5 V ±1 %), input offset voltage (2 mV max)	

✻ .... Under development

AC-DC Converter Controllers

Type No.	Package	Functions	V_{CC} (V)	Features	P
LA5648	DIP8 (300mil)	RCC/external excitation flyback AC-DC converter controller	30	UVLO, primary side P-by-P OCP, secondary side timer OCP	45
✻**LV5038M**	MFP10S (225mil)	AC-DC converter auxiliary power supply controller	30	UVLO, primary side P-by-P OCP, built-in intermittent oscillation transmitter	44

Series Regulators

Type	Type No.	Output current (A)	Output voltage(V)																			Absolute maximum ratings		Package	Features	P
			1.8	2	2.5	3	3.3	3.4	3.5	4	5	6	7	8	9	10	12	15	18	20	24	Input voltage (V)	Total power dissipation (W)			
Positive voltage	**L78M00T**	0.5									○	○	○	○	○	○	○	○	○	○	○	35	1.0	TP3H		
	L78MS05J	0.5									○											35	1.75	TO220-5H	Built-in on/off function	
	L78MS05J -SMP																						2.0	SMP5		
	L780S00	1.0									○	○	○	○	○	○	○	○	○	○	○	35	1.75	TO220-5H	Built-in on/off function	
	L88M00T	0.5					○		○		○	○			○		○					18	1.0	TP3H	Low dropout-voltage	53
	L88MS00T	0.5					○	○		○	○	○		○	○		○					18	1.0	TP5H	On/off function Low dropout-voltage	

Continued on next page

From preceding page

Series Regulators

Type	Type No.	Output current (A)	Output voltage(V)																			Absolute maximum ratings		Package	Features	P
			1.8	2	2.5	3	3.3	3.4	3.5	4	5	6	7	8	9	10	12	15	18	20	24	Input voltage (V)	Total power dissipation (W)			
Positive voltage	**LA5000**	0.06		○		○				○	○											12	0.56	SIP4H	Low dropout-voltage, includes an RF noise suppression pin	
	LA5000M			○		○				○	○	○		○	○	○						12/16	0.3	MFP8 (225mil)		
	L78LR05	0.15									○											25	1.0	TP5H	Provides a reset function, available as ranked products	60
	785✳																						0.16	MSOP8		61
	L78MR00	0.5									○	○		○	○		○					35	1.75	TO220-5H	Reset function	62
	L88R05	1.0									○											18	2.75	TO220-5H	Low dropout-voltage, provides a reset function, available as ranked products	59
Negative voltage	**L79M00T**	0.5									○	○		○	○	○	○					−35	1.0	TP3H		

Dedicated Reset Multifunction Regulator ICs

Type No.	Absolute maximum ratings		Package	Functions/Features	P
	Supply voltage (V)	Total power dissipation (W)			
LA5623M	−0.3 to +12	0.25	MFP8 (225mil)	•Reset circuit that detects the input voltage and provides a 200 ∝s delay time (output 1). •System reset circuit with switchable delay times of 25, 50, 100, and 200 ms (output 2). •Low minimum operating voltage •Both resets (1 and 2) provide hysteresis in their operating voltage.	
LA5608M	10	0.3	MFP14 (225mil)	•Power supply monitor (HALT) signal generation •Microcontroller reset signal generation •Microcontroller interface bus •Makes it easy to prevent incorrect operation when the power supply voltage is lost temporarily. •Built-in microcontroller interface bus for easy interface with microcontrollers.	

Shunt Regulators

Type No.	Cathode current (mA)	Output voltage setting range (v)	Absolute maximum ratings		Package	Functions/Features	P
			Input voltage (V)	Total power dissipation (W)			
L5431	1 to100	Vref to 36	37	0.75	NP	High-precision variable shunt	

LA5660M

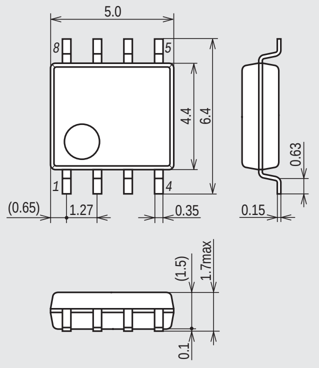
Application

Single-channel general-purpose switching regulator IC

Functions/Features

- Operates from 1.8 V.
- Upconverter operation
- On/off control function

MFP8 (225mil)



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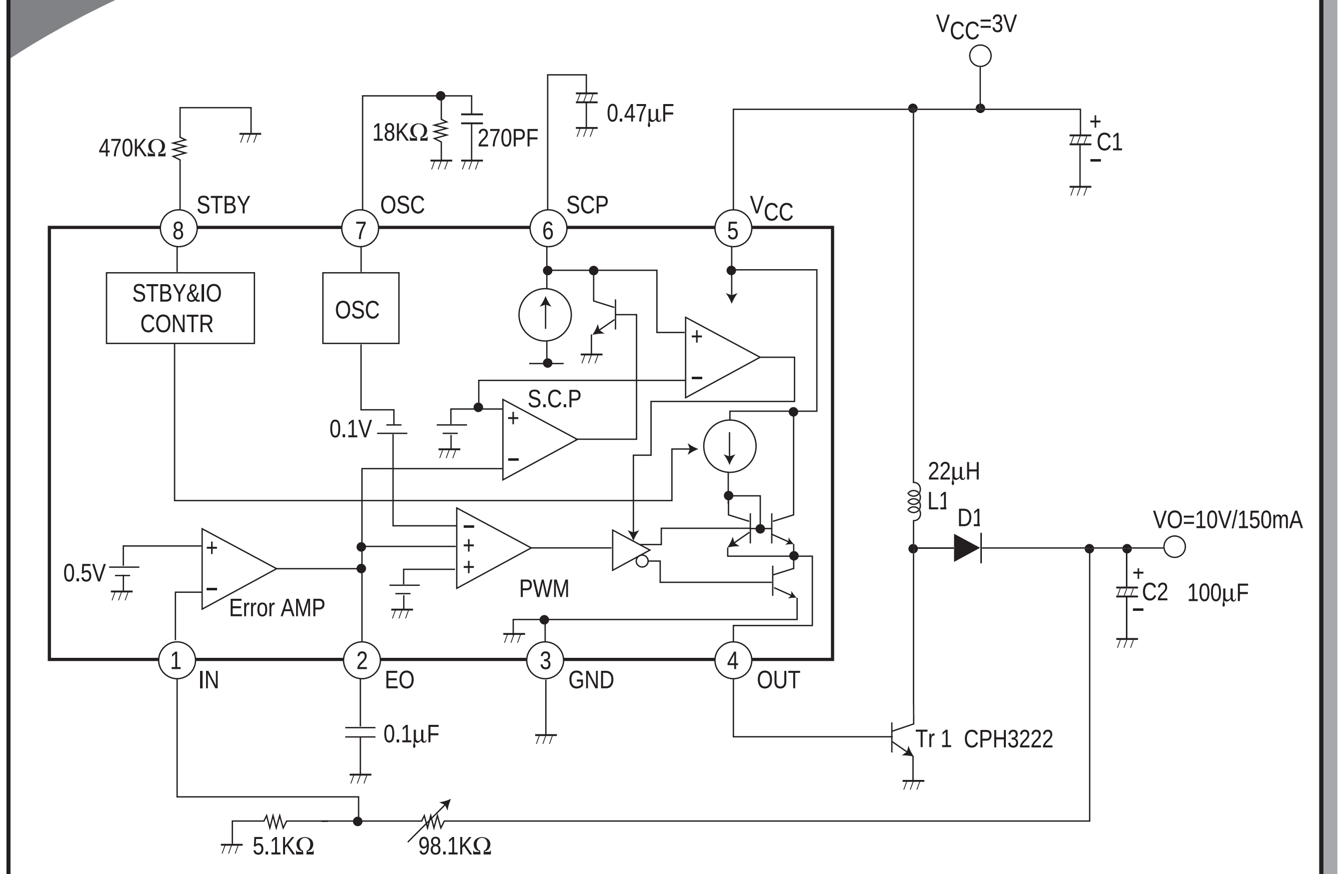


LA5662M

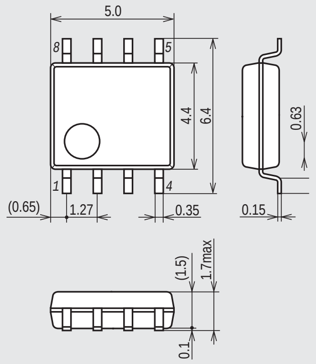
Application

Single-channel general-purpose switching regulator IC

Functions/Features

- Operates from 1.8 V.
- Downconverter operation
- On/off control function

MFP8 (225mil)



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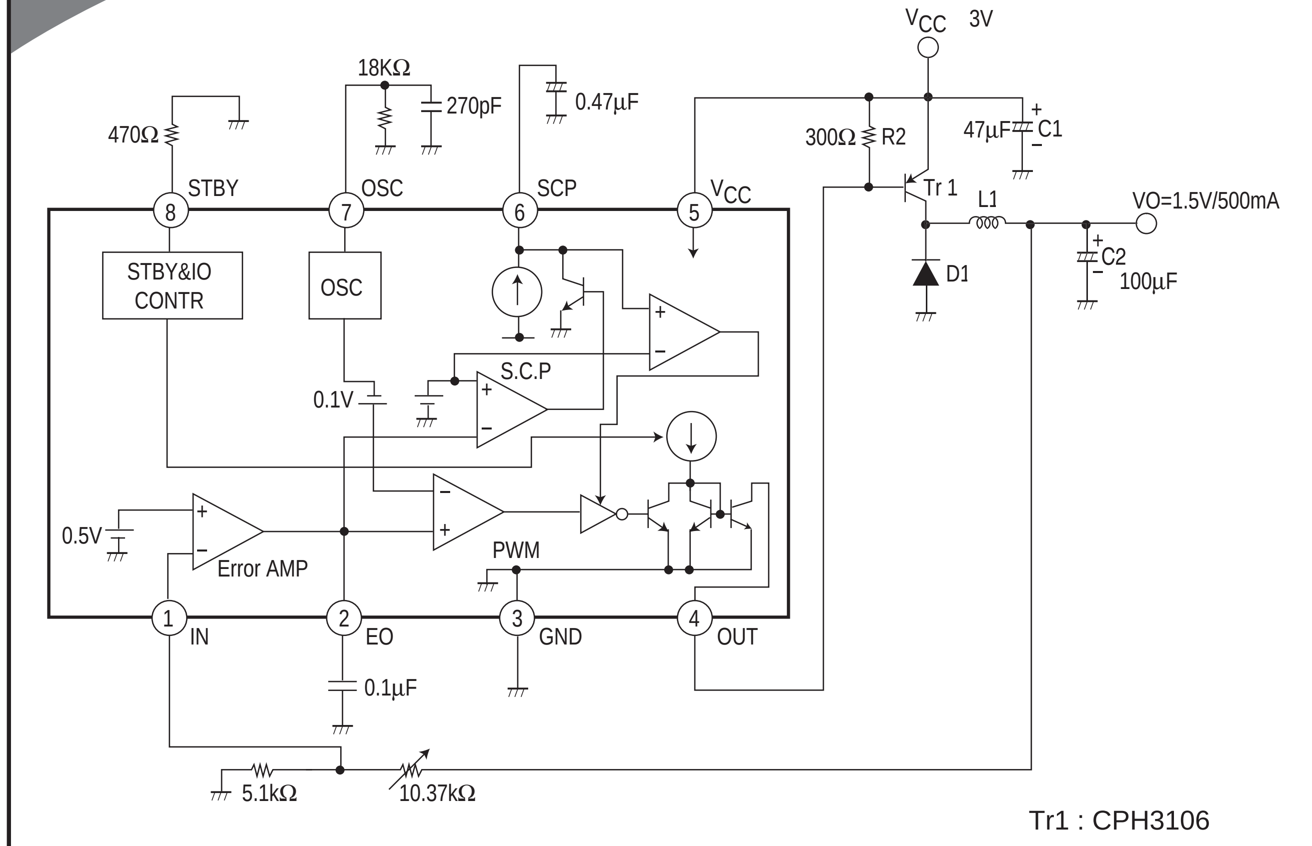


Tr1 : CPH3106

LA5664M

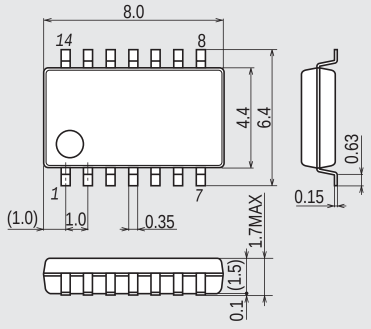
Application

Voltage step up/down switching regulator IC

Functions/Features

- Built-in 5.7 V switching regulator circuit
- Supports on/off control.
- Soft start function
- One 5 V low saturation-voltage regulator circuit (I_O = 250 mA)

MFP14S (225mil)



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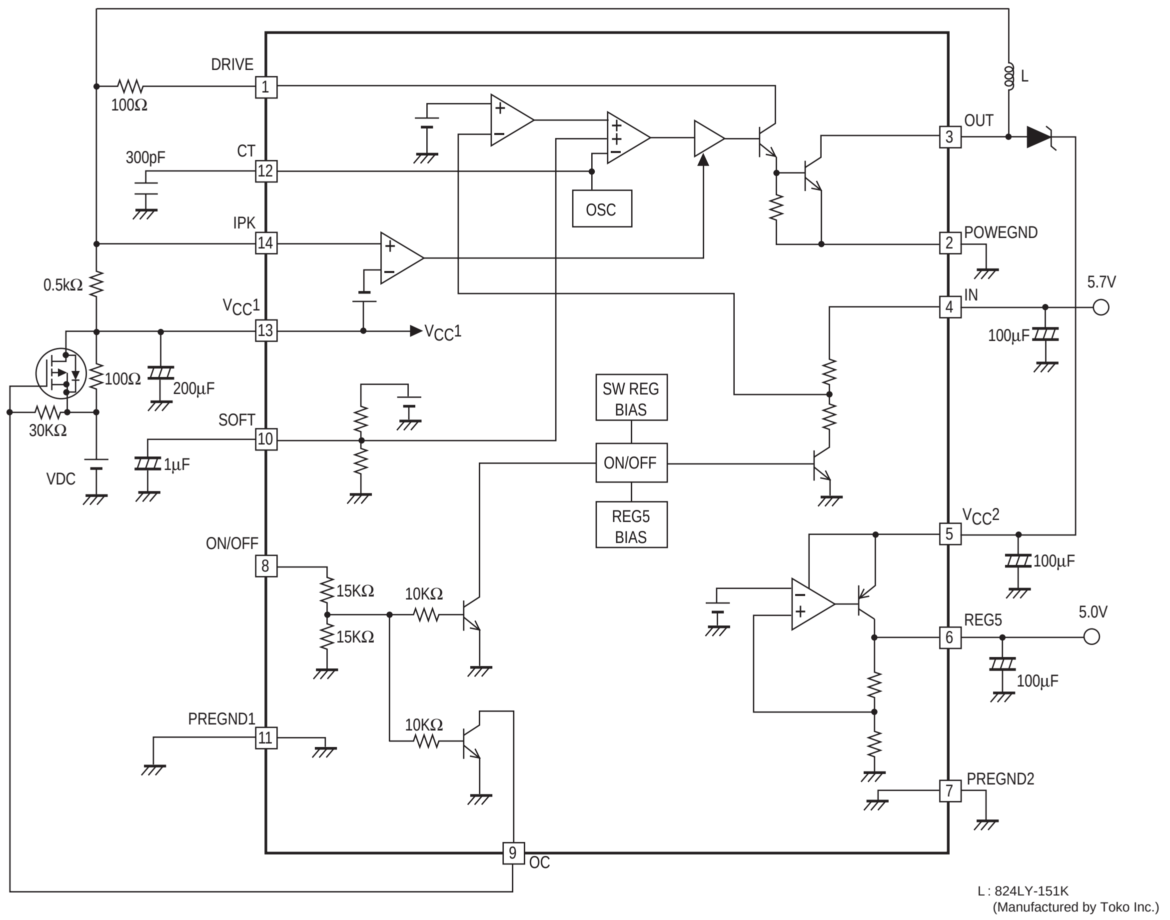


L : 824LY-151K
(Manufactured by Toko Inc.)

LA5649T

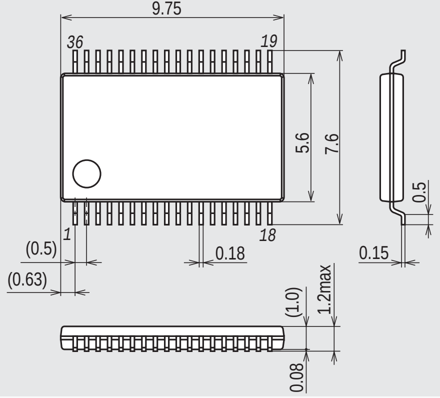
Application

Three-channel switching regulator IC for digital cameras

Functions/Features

- Supports low-voltage operation, minimum: 1.8 V.
- Includes independent standby circuits for each of the three channels.
- Reference voltage accuracy: ±1%

TSSOP36 (275mil)



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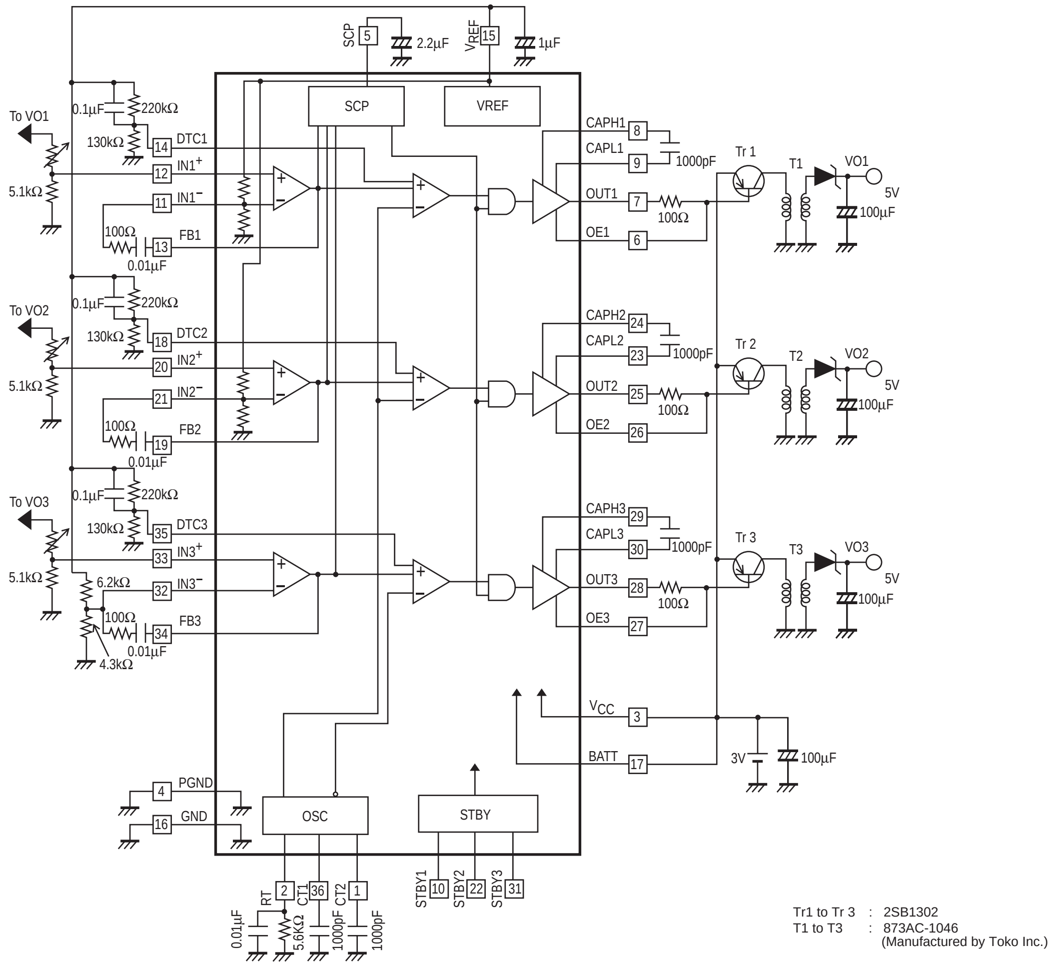


Tr1 to Tr 3 : 2SB1302
T1 to T3 : 873AC-1046
(Manufactured by Toko Inc.)

LA5679T

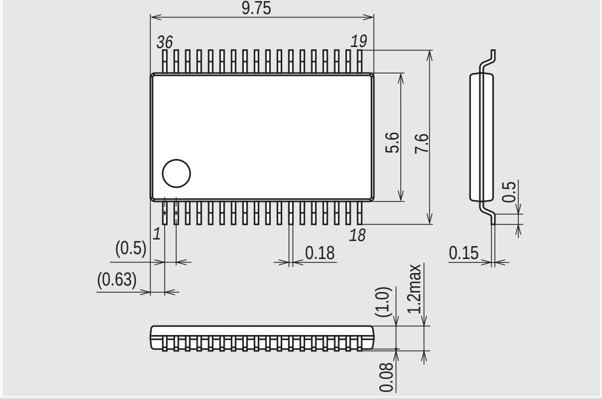
Application

Three-channel switching regulator for digital cameras

Functions/Features

- Supports low-voltage operation, minimum: 1.8 V.
- OUT1 drives an external pnp transistor.
- OUT2 and OUT3 drive external npn transistors.
- Includes independent standby circuits for each of the three channels.
- Reference voltage accuracy: ±1%
- Capable of driving MOS transistors

TSSOP36 (275mil)



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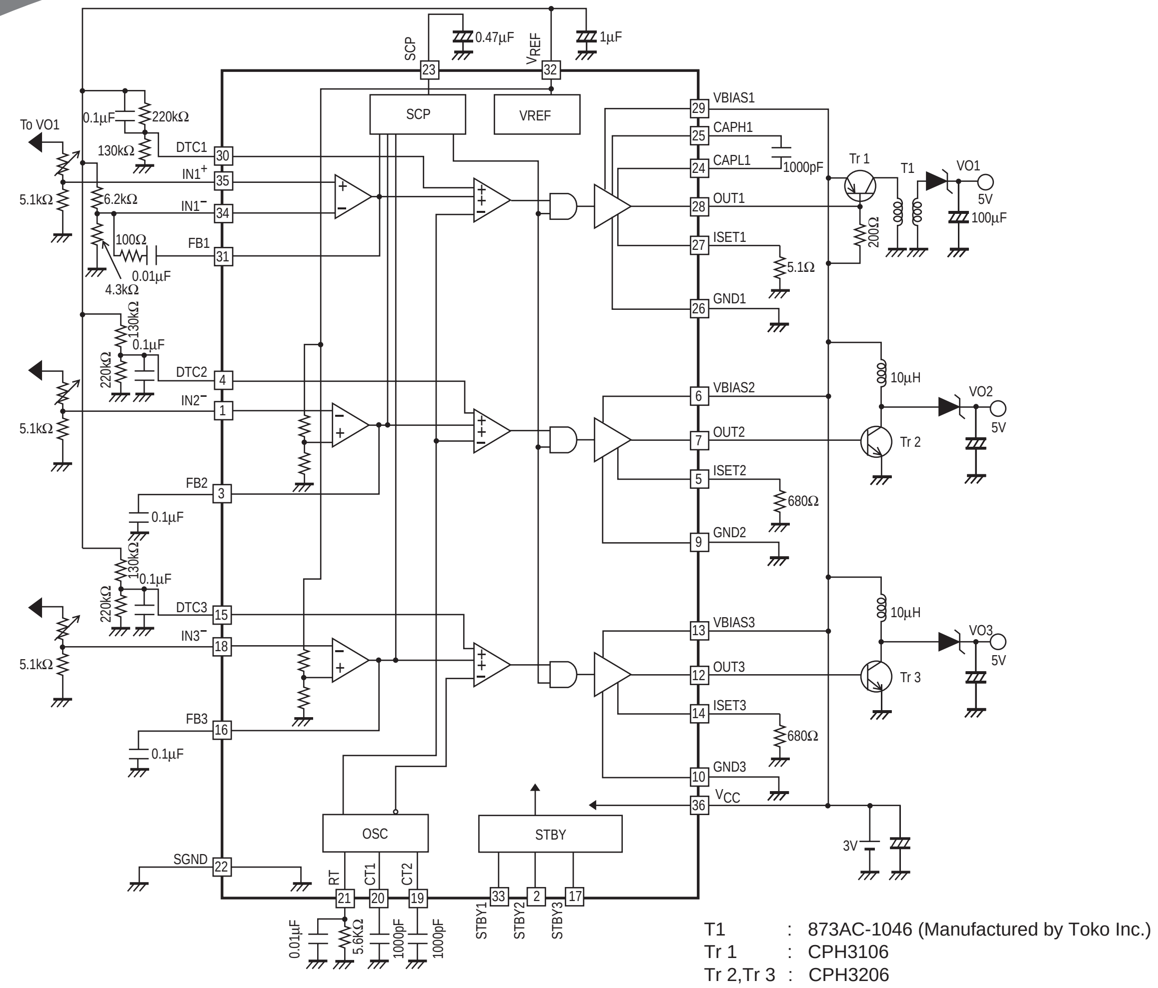


T1 : 873AC-1046 (Manufactured by Toko Inc.)
Tr 1 : CPH3106
Tr 2,Tr 3 : CPH3206

LA5627W

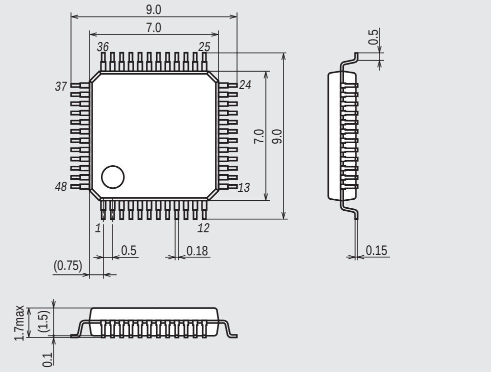
Application

Four-channel switching regulator IC for digital cameras

Functions/Features

- Supports low-voltage operation, minimum: 1.8 V. (When the internal subsidiary-supply is not used.)
- Supports operation at voltages as low as 1.2 V when the internal subsidiary-supply is used.
- Includes independent standby circuits for each of the four channels.

SQFP48 (7×7)



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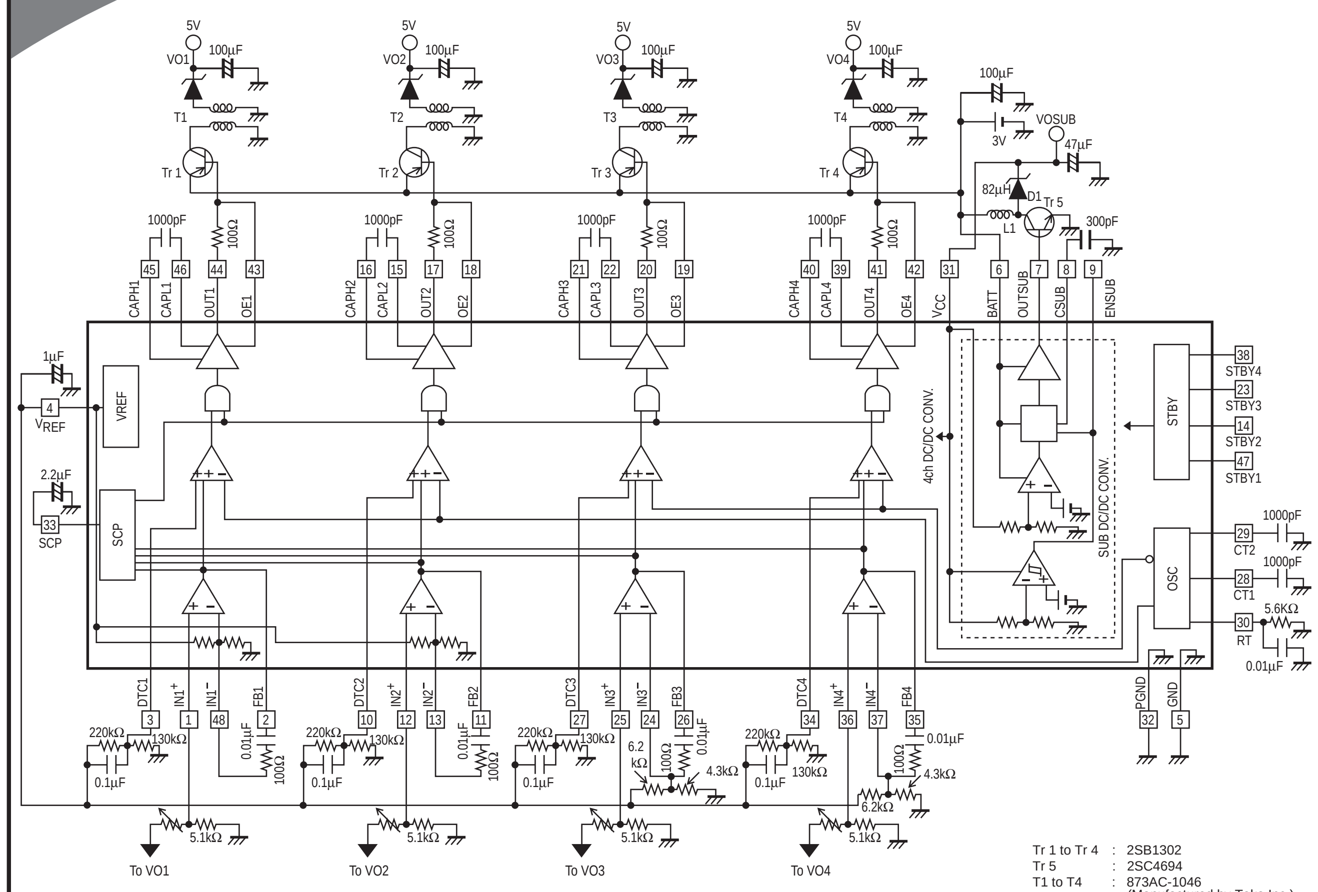


Tr 1 to Tr 4 : 2SB1302
Tr 5 : 2SC4694
T1 to T4 : 873AC-1046 (Manufactured by Toko Inc.)
L1 : 636CY-820M (Manufactured by Toko Inc.)

Switching Regulators

LA5683T

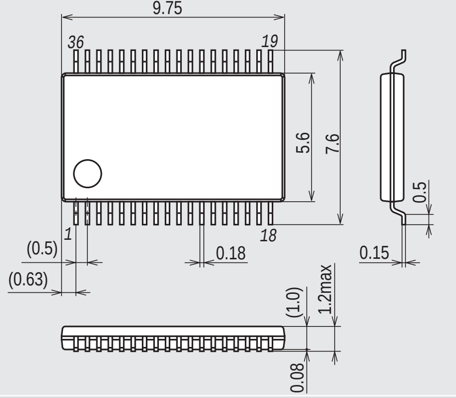
Application

Four-channel switching regulator IC for digital cameras

Functions/Features

- Supports low-voltage operation, minimum: 1.8 V.
- OUT1 and OUT2 drive external pnp transistors
- OUT3 and OUT4 drive external npn transistors
- Includes independent standby circuits for each of the four channels.
- Reference voltage accuracy: ±1%
- Capable of driving MOS transistors
- The channel 2 dead time is fixed internally, the preset duty cycle is 100%.
  (Channels 1, 3, and 4 are set externally.)

TSSOP36 (275mil)



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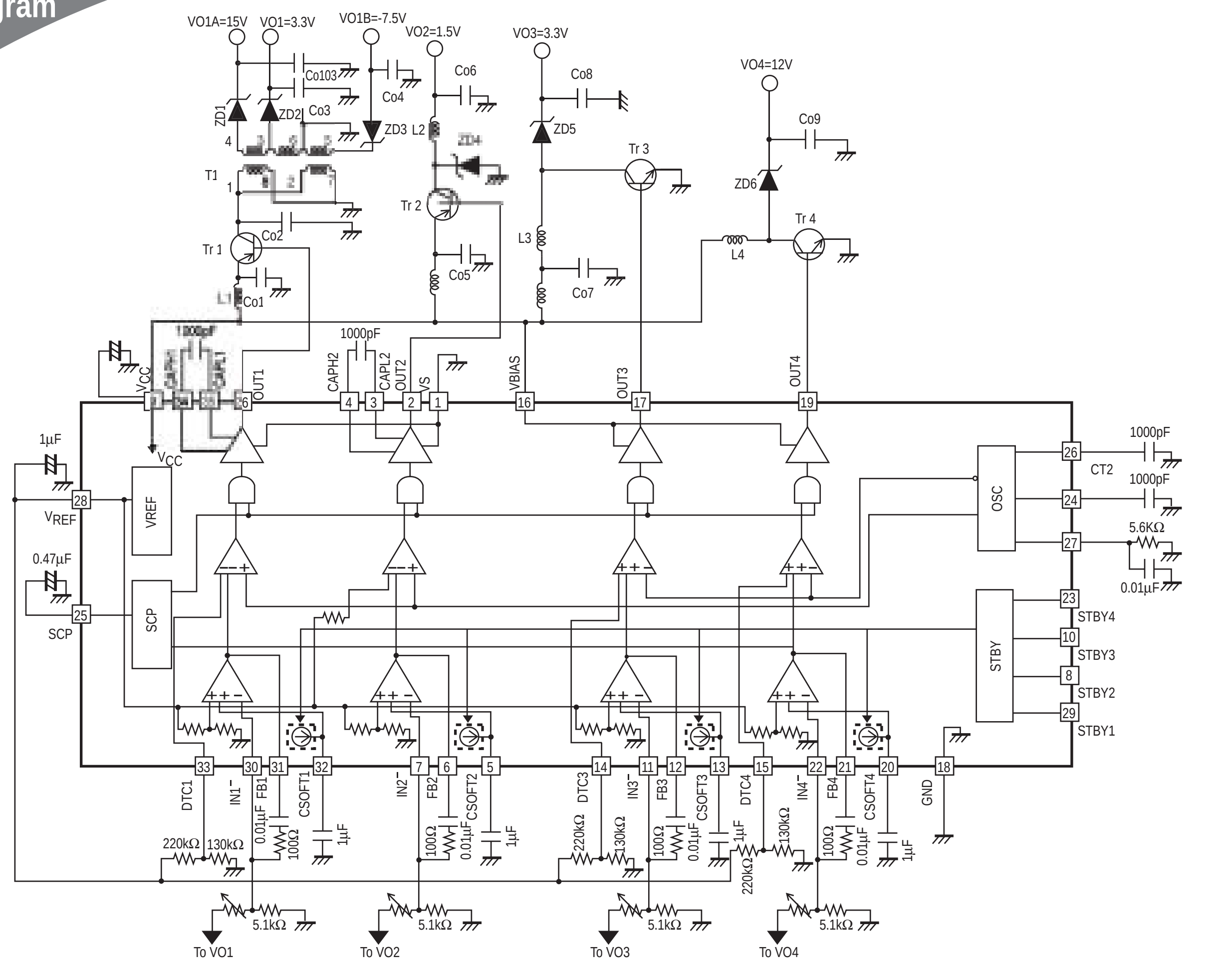


Switching Regulators

LA5680T

New product

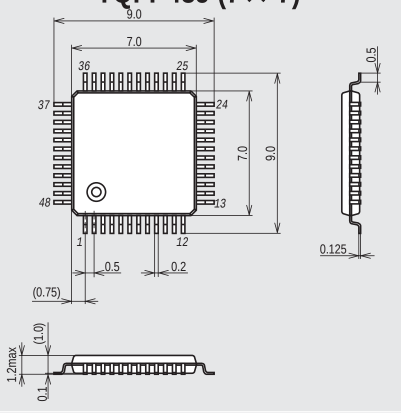
Application

Six-channel switching regulator control IC

Functions/Features

- Supports low-voltage operation (minimum: 1.5 V).
- Reference voltage precision: ±1%
- Independent six-channel standby circuit
- OUT1 and OUT2 drive external pnp transistors
- OUT3 to OUT6 drive external npn transistors
- Outputs can drive MOS transistors.
- Channels 1 and 2 have an internally fixed dead time and a set duty of 100%.
- Channels 3 to 6 have an internally fixed dead time and a set duty of 85%.

TQFP48J (7 × 7)



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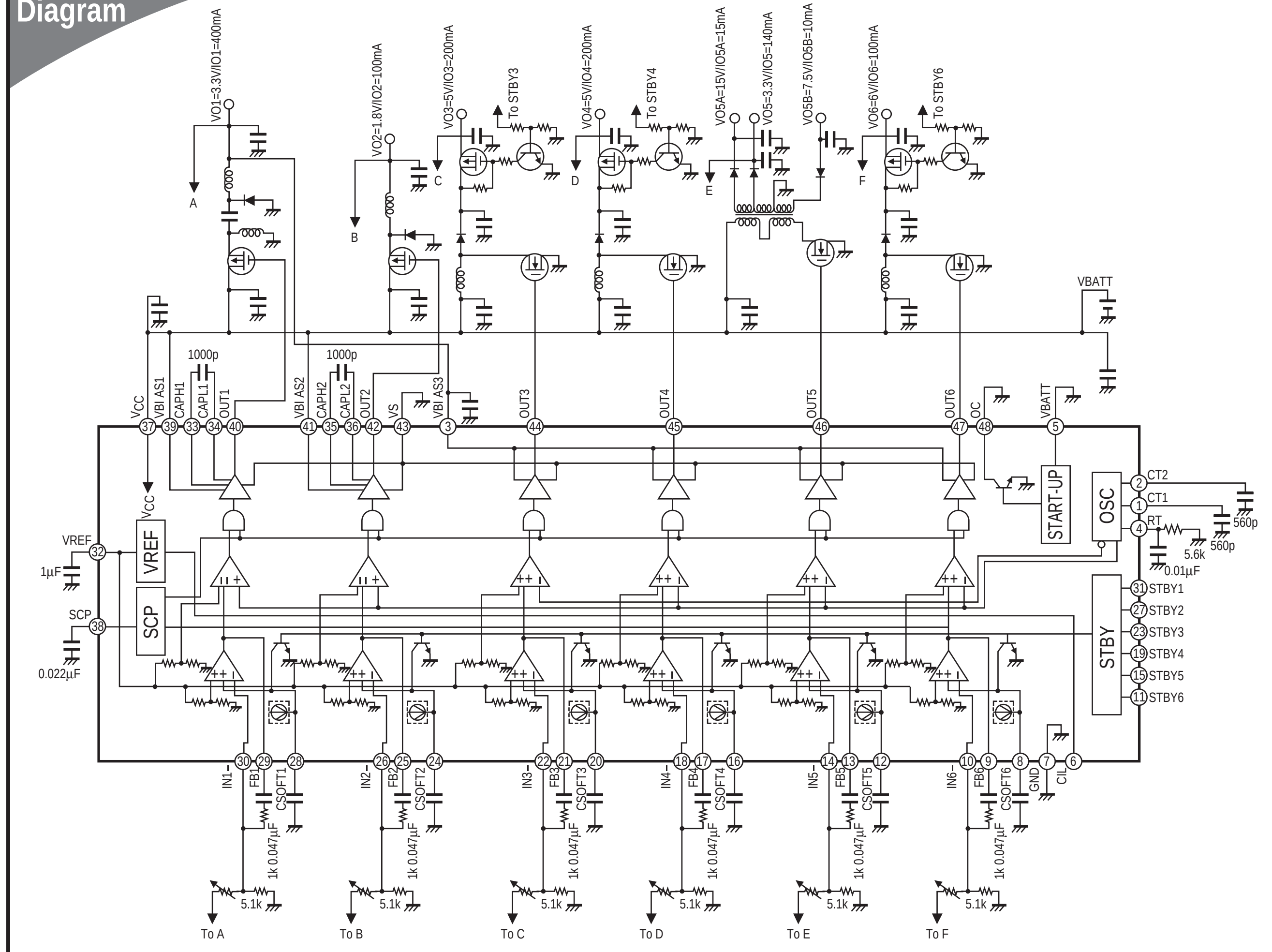


External Excitation Step-Down Switching Regulators

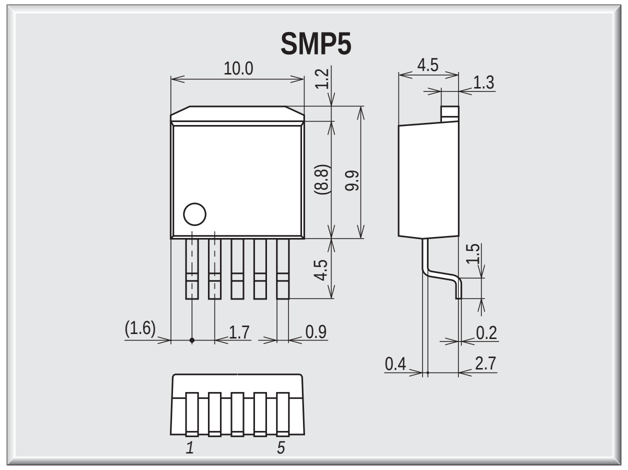
LA5771MP/72MP

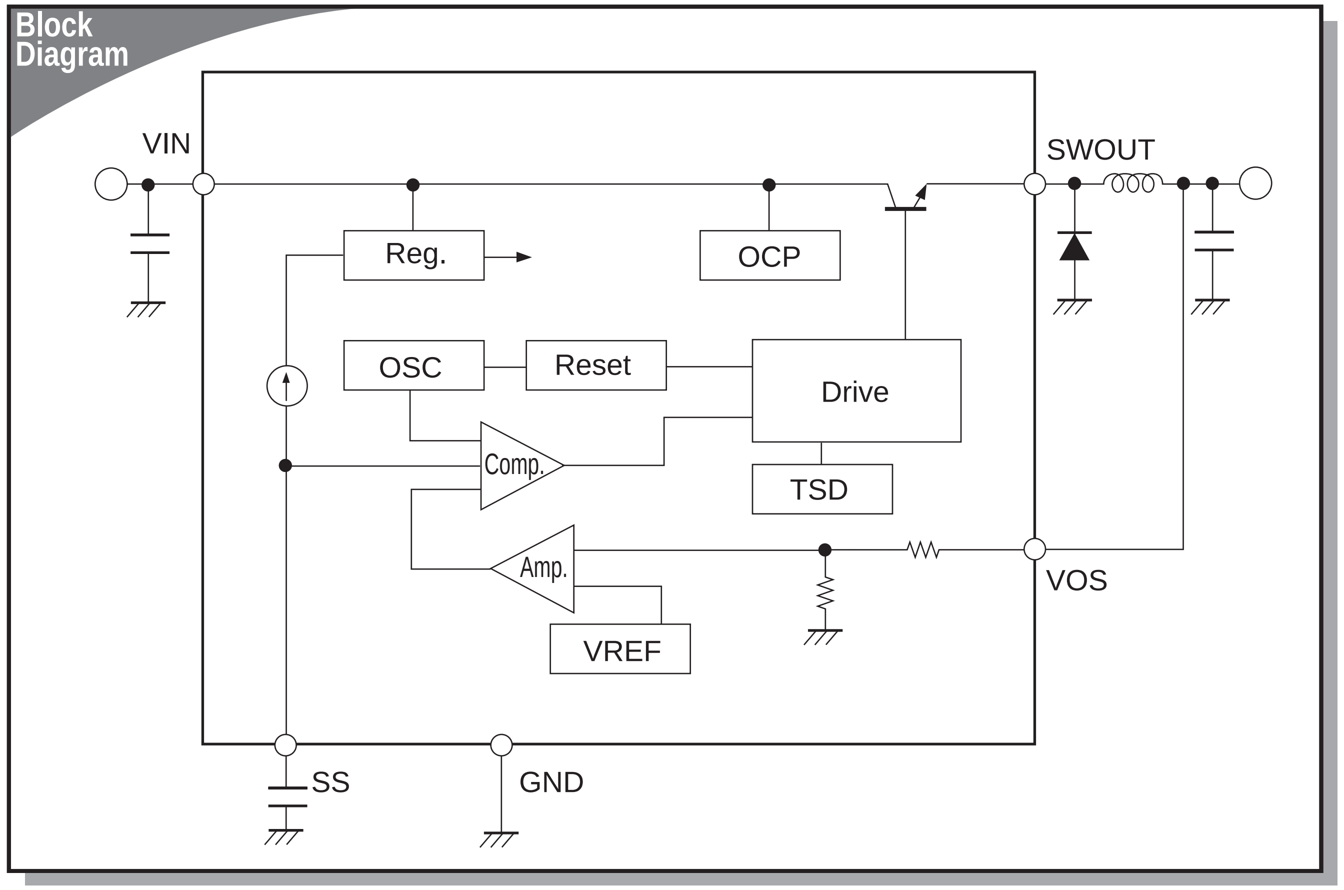
Application

External excitation step-down switching regulator ICs

Functions/Features

- High efficiency
- Only 4 external parts required
- Built-in reference oscillator (160KHz)
- Current limiter circuit
- Thermal shutdown circuit
- Soft start circuit
- Wide input voltage range: up to 30V
- IOmax: 3A
- Vout 3.3V (LA5771MP)
  5V (LA5772MP)





External Excitation Step-Down Switching Regulators

LA5751/52/53/54 New product

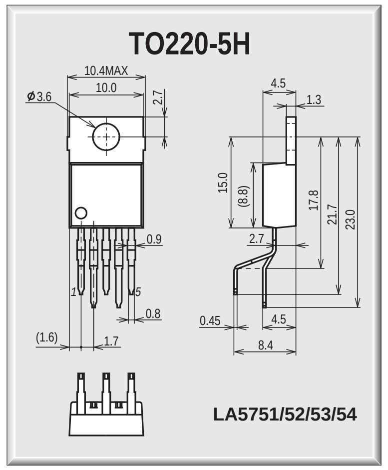
LA5751MP/52MP/53MP/54MP

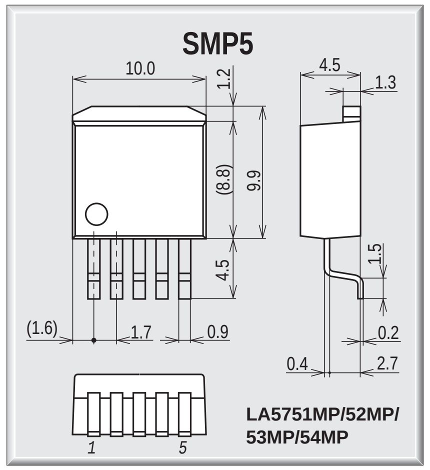
Application

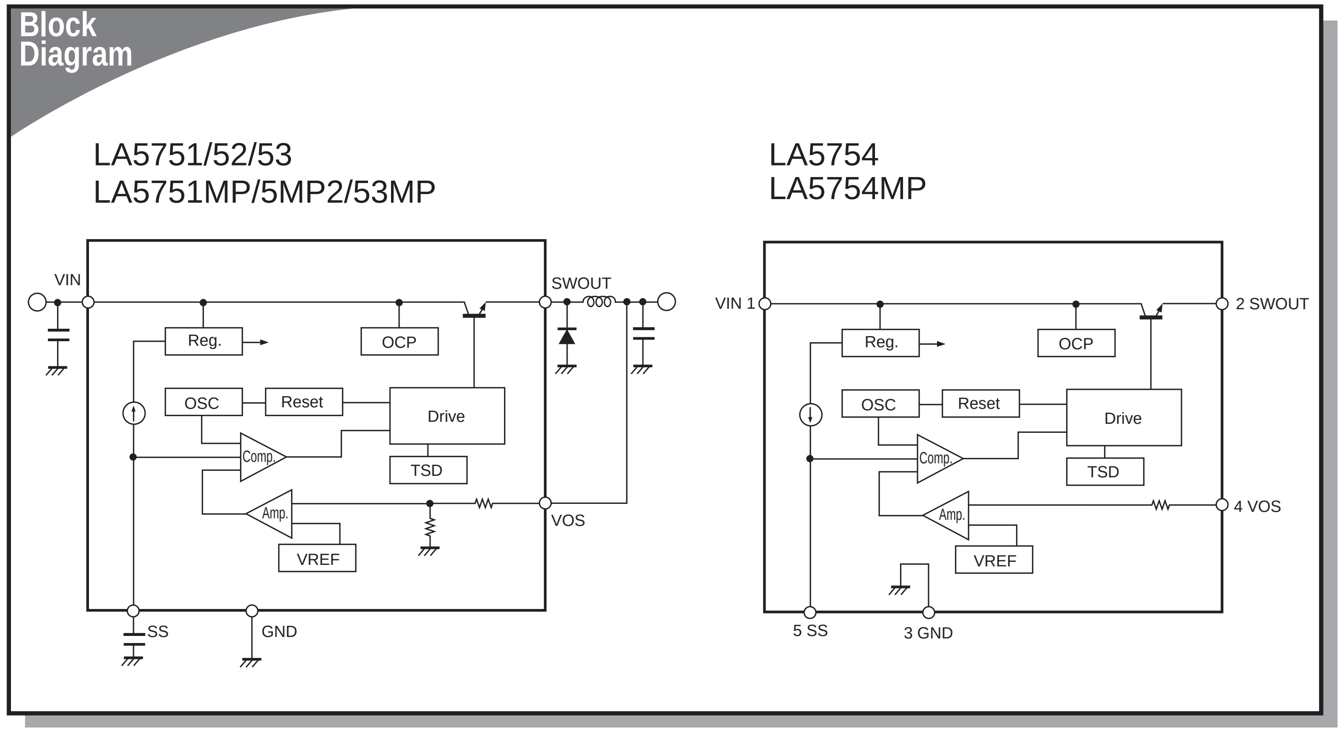
External excitation step-down switching regulator ICs

Functions/Features

- High efficiency
- Only 4 external parts required
- Built-in reference oscillator (60KHz)
  LA5751/51MP, LA5752/52MP
  LA5753/53MP
- Built-in reference oscillator (120KHz)
  LA5754/54MP
- Current limiter circuit
- Thermal shutdown circuit
- Soft start circuit
- Wide input voltage range: up to 30V
- IOmax: 3A
- Vout 3.3V (LA5751/51MP)
  5V (LA5752/52MP)
  12V (LA5753/53MP)
  Variable (LA5754/54MP)







Synchronous Rectification Switching Regulator

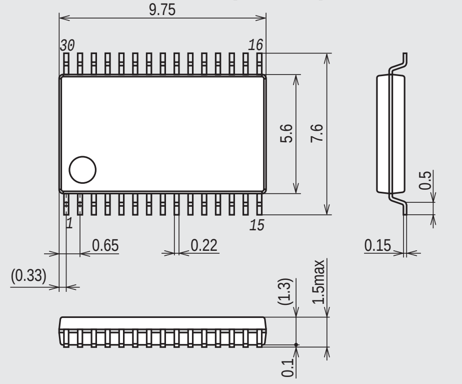
LV5040V

New product

Application

Two-channel general-purpose switching regulator IC

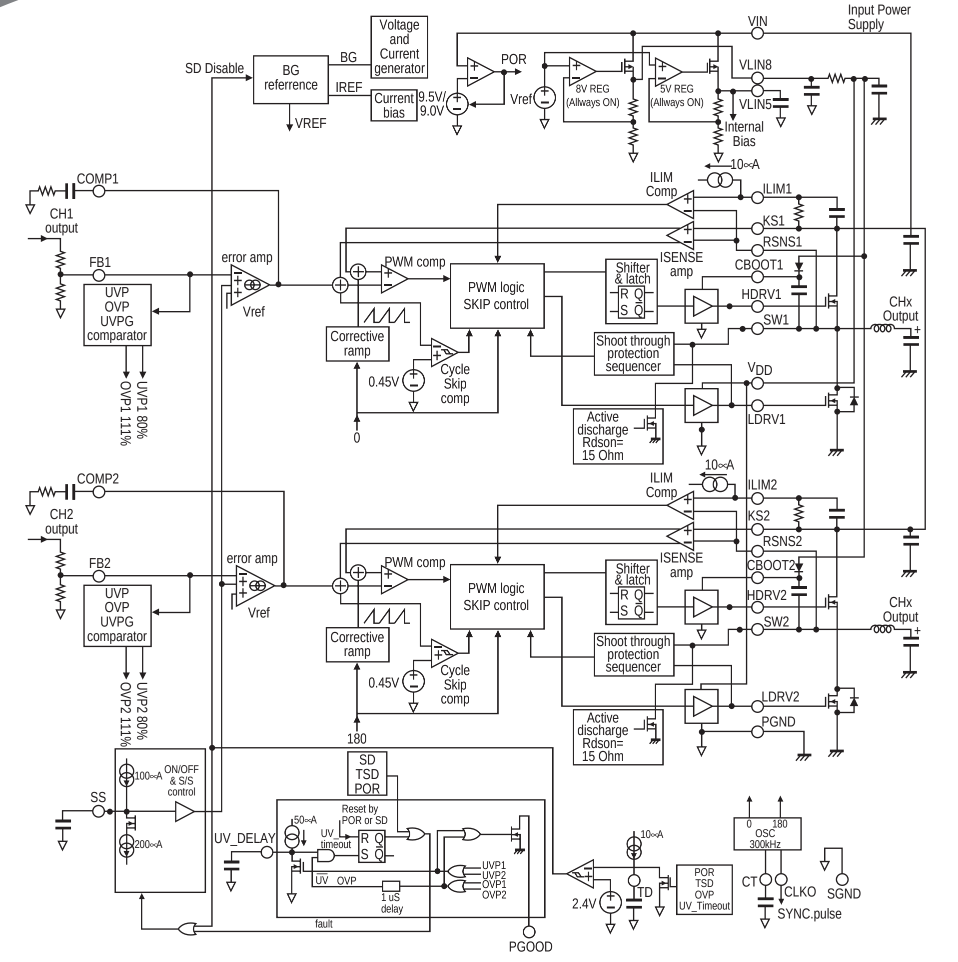
SSOP30 (275mil)



Functions/Features

- Two-circuit input step-down DC-DC converter controller
- Input undervoltage lockout (UVLO) circuit, overcurrent detection function, and overtemperature detection function, soft start/soft stop functions, startup delay circuit
- Output voltage monitoring functions (Supply voltage check, overvoltage protection, and undervoltage protection with timer latch functions)
- Interleaved operation with 180° between phases 1 and 2 (Also supports multiphase operation with the two phases operating in parallel.)
- Supports synchronous operation between devices with differing types. (Supports master-slave operation when multiple devices are used.)

Block Diagram



Synchronous Rectification Switching Regulator

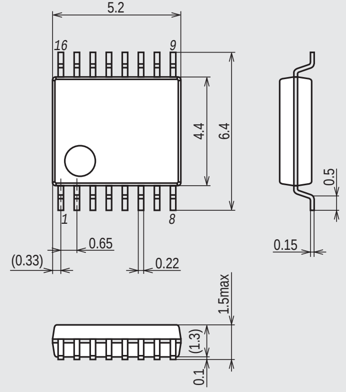
LV5047V

Under development

Application

Synchronous rectification step-down DC-DC converter controller IC

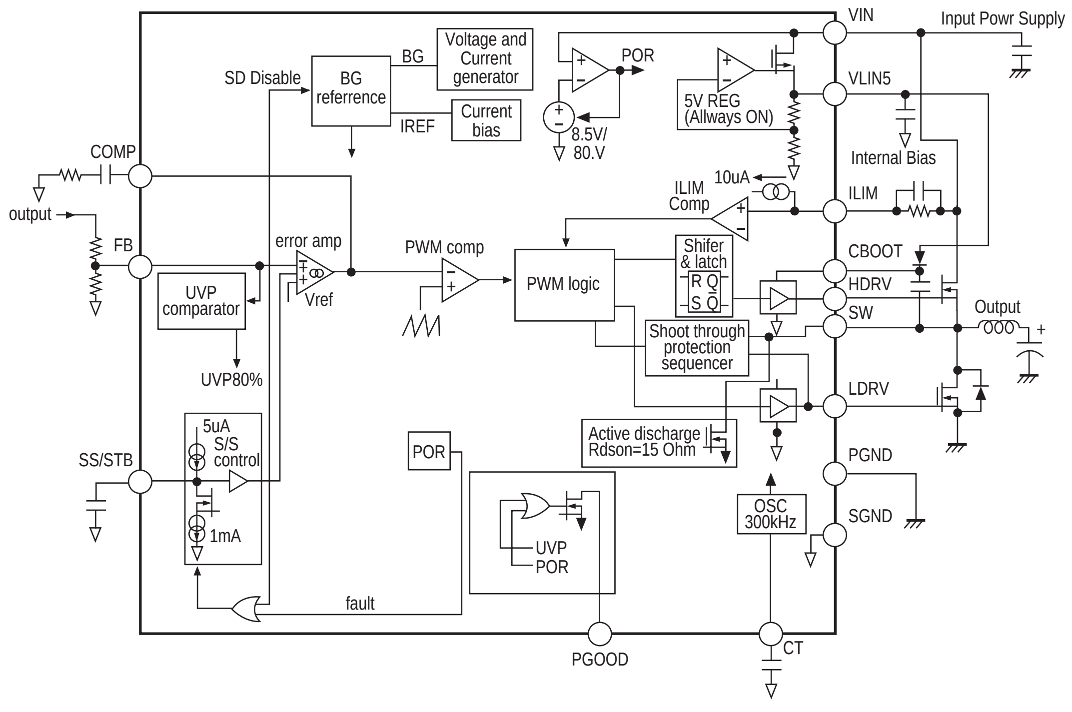
SSOP16 (225mil)



Features

- Synchronous rectification step-down DC-DC converter controller
- Input undervoltage lockout (UVLO) circuit, pulse-by-pulse overcurrent detection function, soft start/soft stop functions
- Function to prevent simultaneous conduction of both top and bottom MOSFETs
- PGOOD output, built-in bootstrap circuit
- Construct synchronous rectification converter circuit with less external components

Block Diagram



Synchronous Rectification Switching Regulator

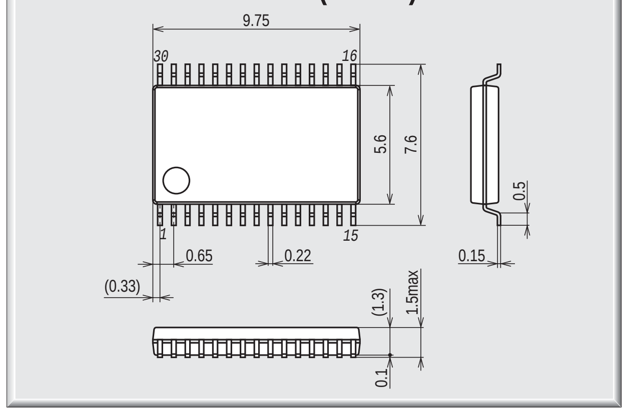
LV5042V

Under development

Application

Two-channel step-down DC-DC converter controller IC

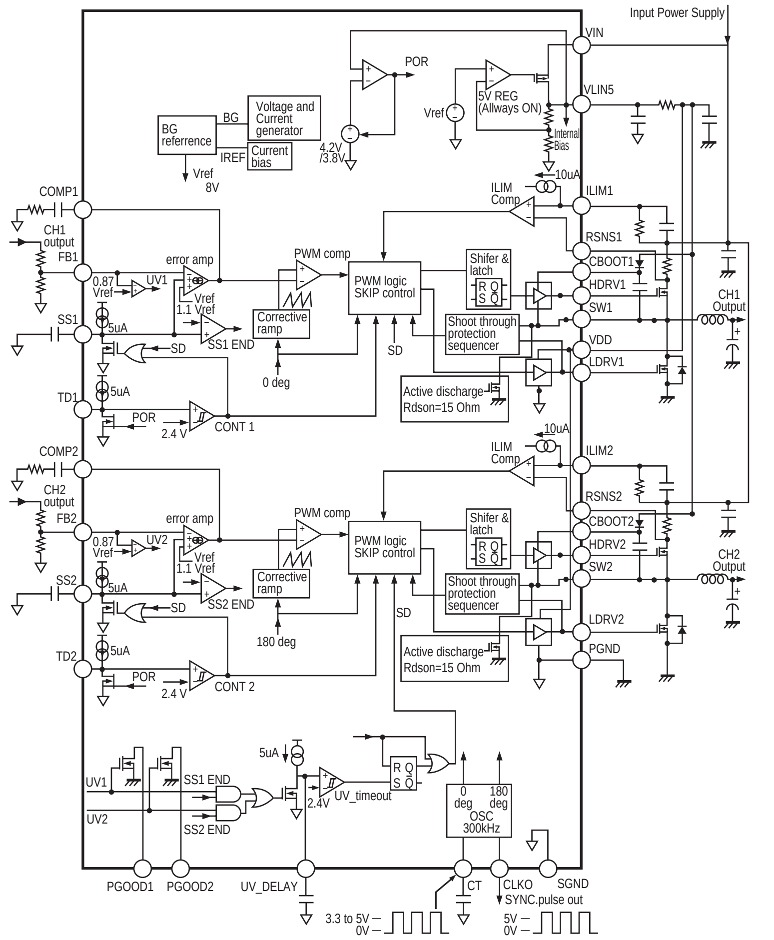
SSOP30 (275mil)



Features

- Two-channel step-down DC-DC converter controller
- Input undervoltage lockout (UVLO) circuit, overcurrent detection function, soft start/soft stop functions, and startup delay circuit
- Output voltage monitoring functions (power good function and undervoltage protection with timer latch functions)
- Interleaved operation with180° between phases 1 and 2
- Supports synchronous operation with external devices (Supports master-slave operation when multiple devices are used.)

Block Diagram



Synchronous Rectification Switching Regulator

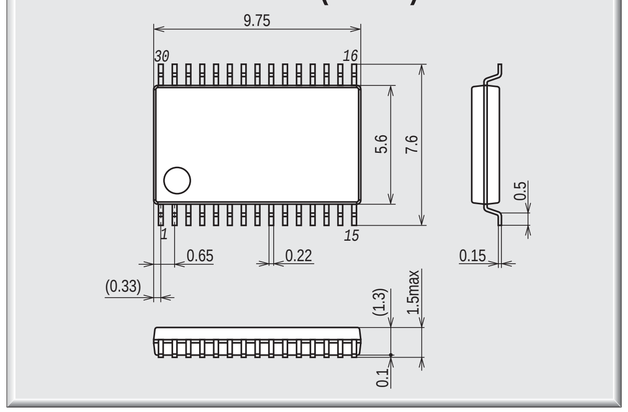
LV5043V

Under development

Application

Two-channel step-down DC-DC converter controller IC

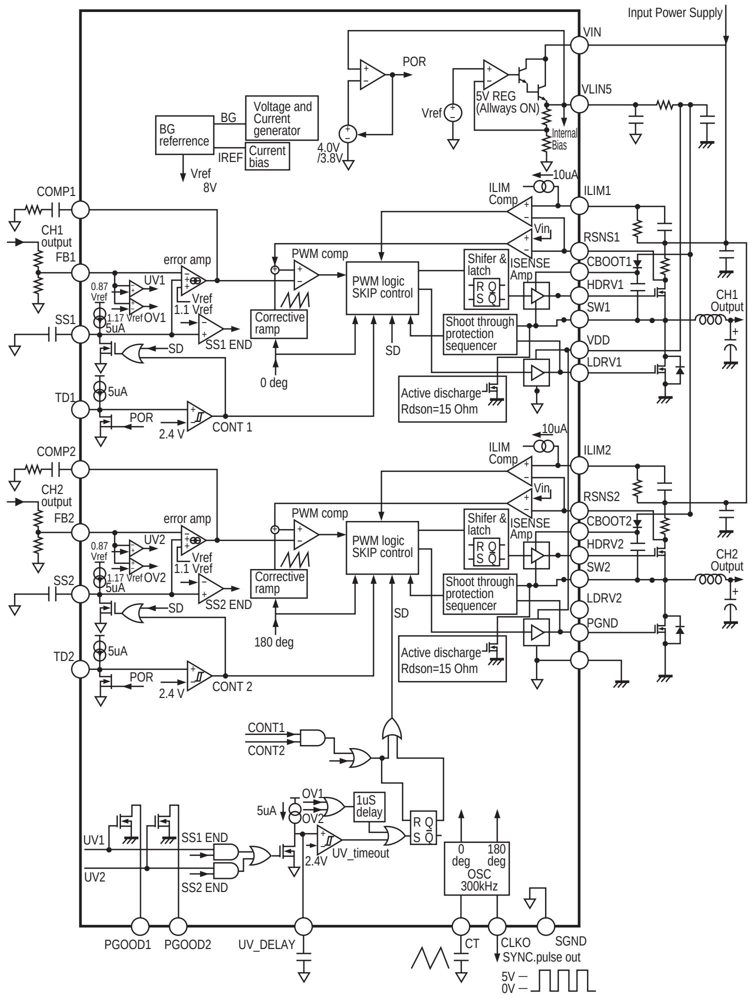
SSOP30 (275mil)



Features

- Two-channel step-down DC-DC converter controller
- Input undervoltage lockout (UVLO) circuit, overcurrent detection function, soft start/soft stop functions, and startup delay circuit
- Output voltage monitoring functions (power good function and undervoltage protection with timer latch functions)
- Interleaved operation with 180° between phases 1 and 2
- Supports synchronous operation with external devices (Supports master-slave operation when multiple devices are used.)

Block Diagram



Switching Regulator + Linear Regulator (multi-regulator)

LV5045V

Under development

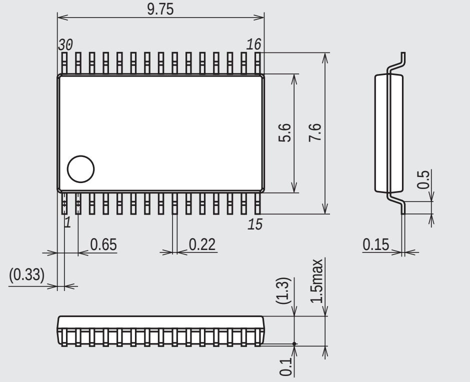
Application

Set-top box power supply IC

Features

- 5 power supplies
  Switching regulator (Shottky rectifier): 2
  Reverse charge pump: 1
  Linear regulator: 2
- Power good functions
- Under (no) voltage delay (UVD) circuit
- Thermal protection circuit
- Soft start function

SSOP30 (275mil)



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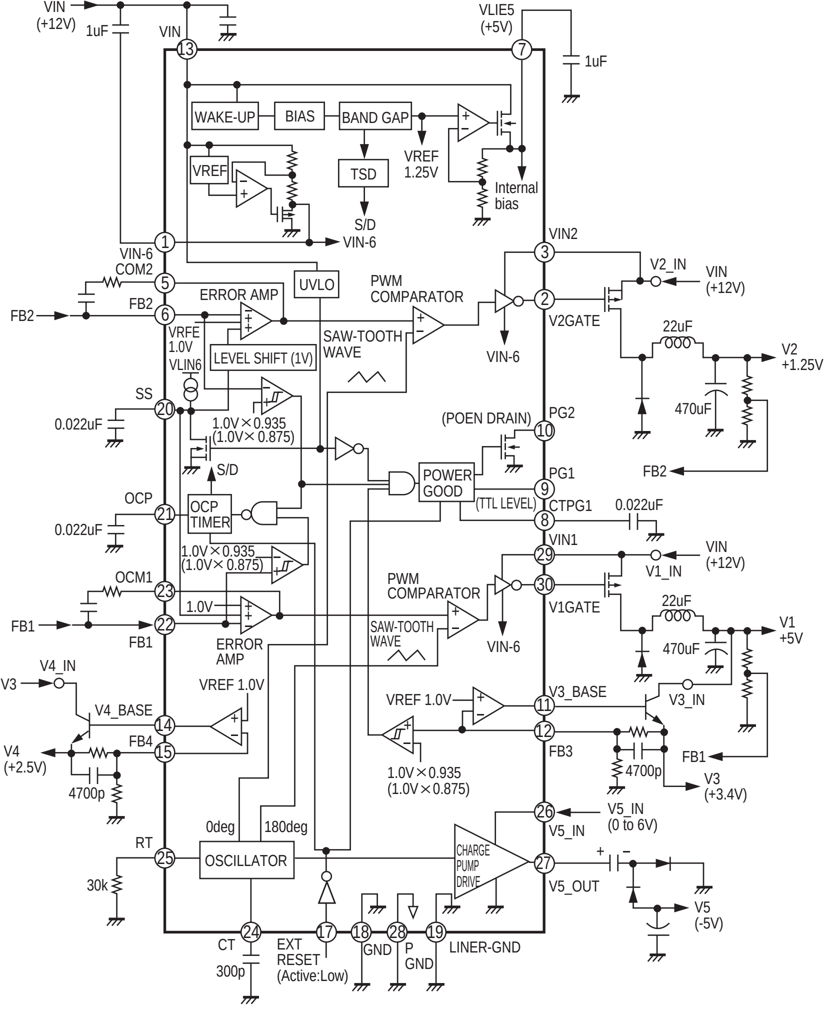


Power IC for Portable CD Players

LV5051T

New product

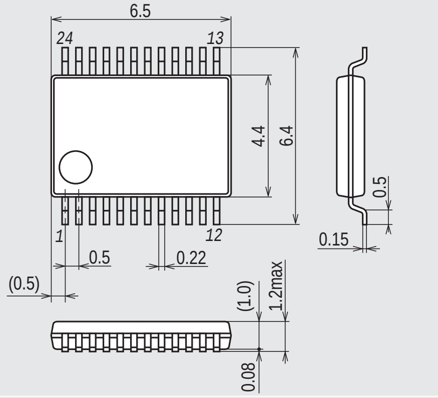
Application

Power IC for portable CD players

Features

- 2.5V step-up/down DC-DC converter
- VG step-up circuit for power MOSFET driving
- 2.8V/3.9V regulator control circuit
  (with switching terminal)
- Undervoltage lockout (UVLO) circuit (PVCC1)
- ACDET detection output terminal
- Microcontroller RESET output terminal
- 2.5V (OUT2) pin control input terminal

TSSOP24 (225mil)



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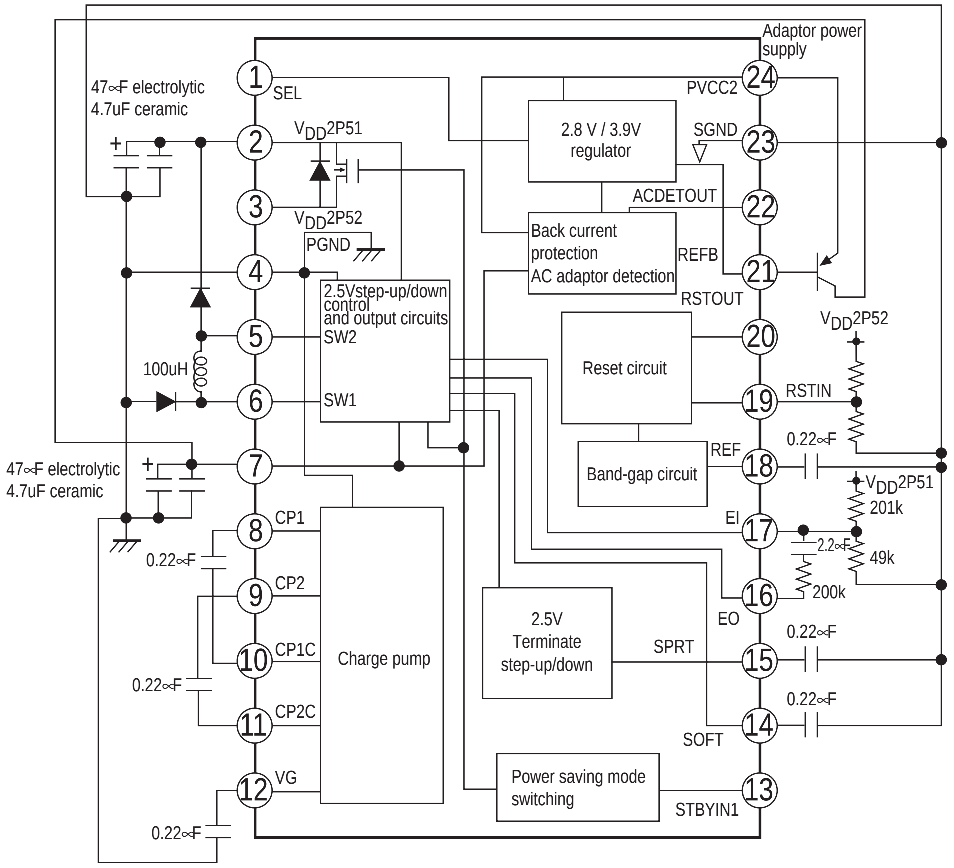


Cellular Phone System Power Supplies

LV5105FN

New product

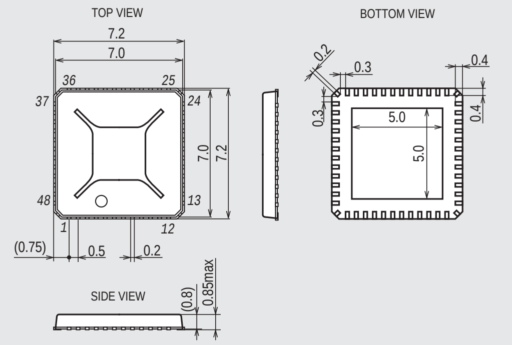
Application

Cellular phones

Functions/Features

- Includes four regulator circuits (CMOS outputs).
- Built-in detection circuits
  (One for REG1 and one for VBAT (with reset output))
- Three-color LED drivers (with charge pump 5 V output)
- Front LED driver
- Microphone bias output
- Thermal protection circuit

VQFN48 (7×7)



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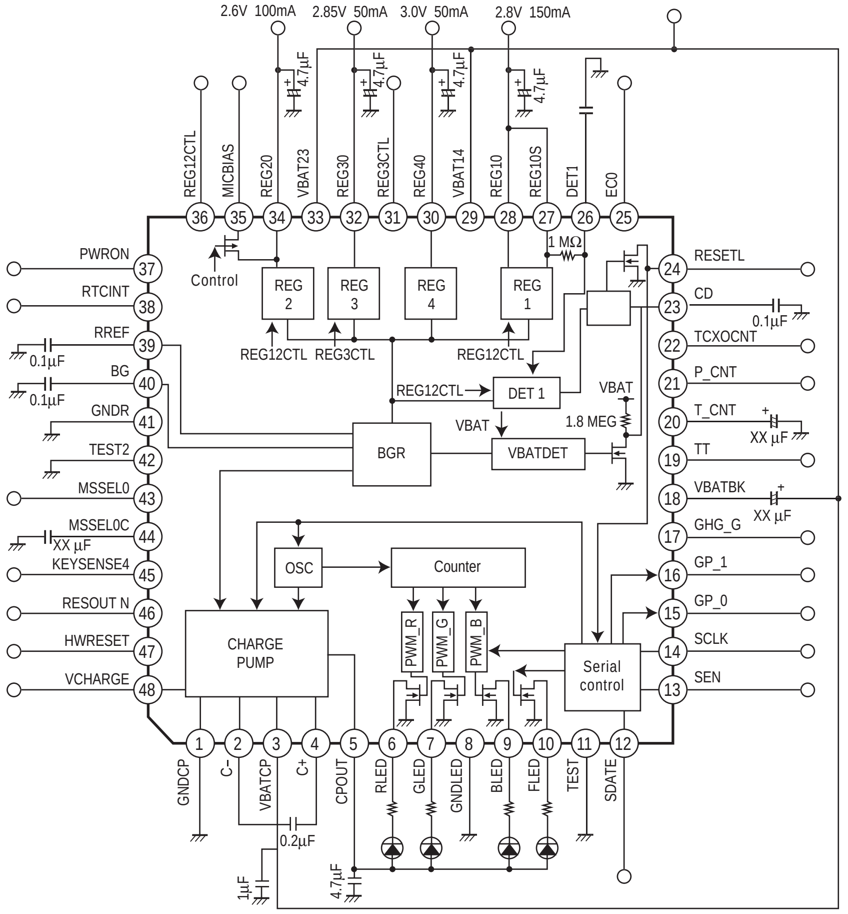


AC-DC Converter Control ICs

LV5038M

Under development

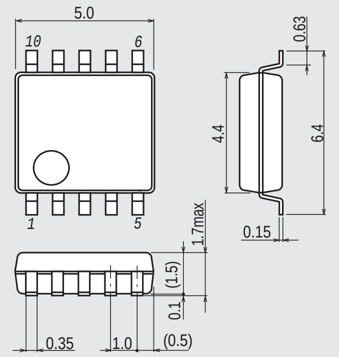
Application

Auxiliary power supply AC-DC converter controller

Functions/Features

- PWM operation based on external excitation and reset signals.
  Built-in intermittent operation switching function
- Fixed-duty intermittent operation switching function
- Under-voltage-lockout function built-in
- P-by-P primary side OCP detection circuit

MFP10S (225mil)



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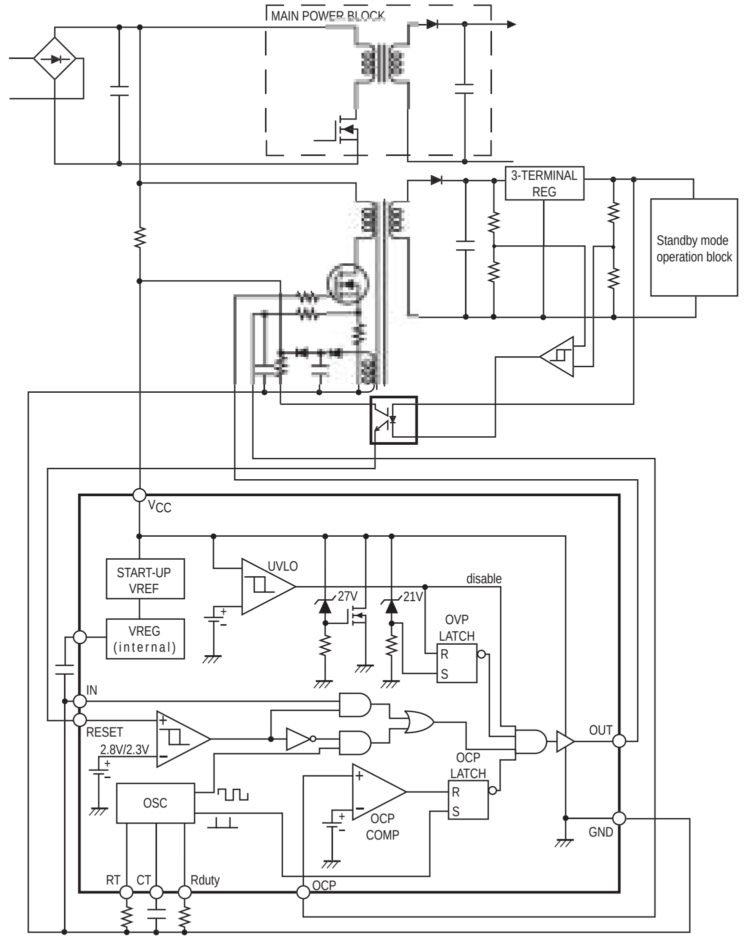


AC-DC Converter Control ICs

LA5648

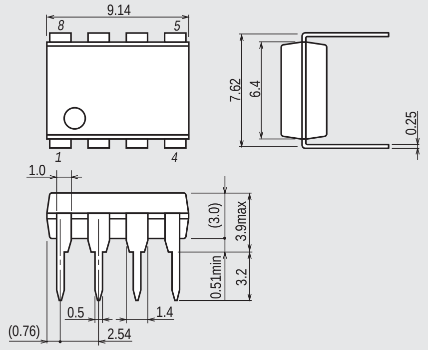
Application

RCC/external excitation AC-DC converter controller

Functions/Features

- RCC power supply controller
- Primary side overcurrent detection function (P-by-P)
- Built-in UVLO circuit
- Secondary side overcurrent detection (with timer)
- Base winding voltage detection function

DIP8 (300mil)



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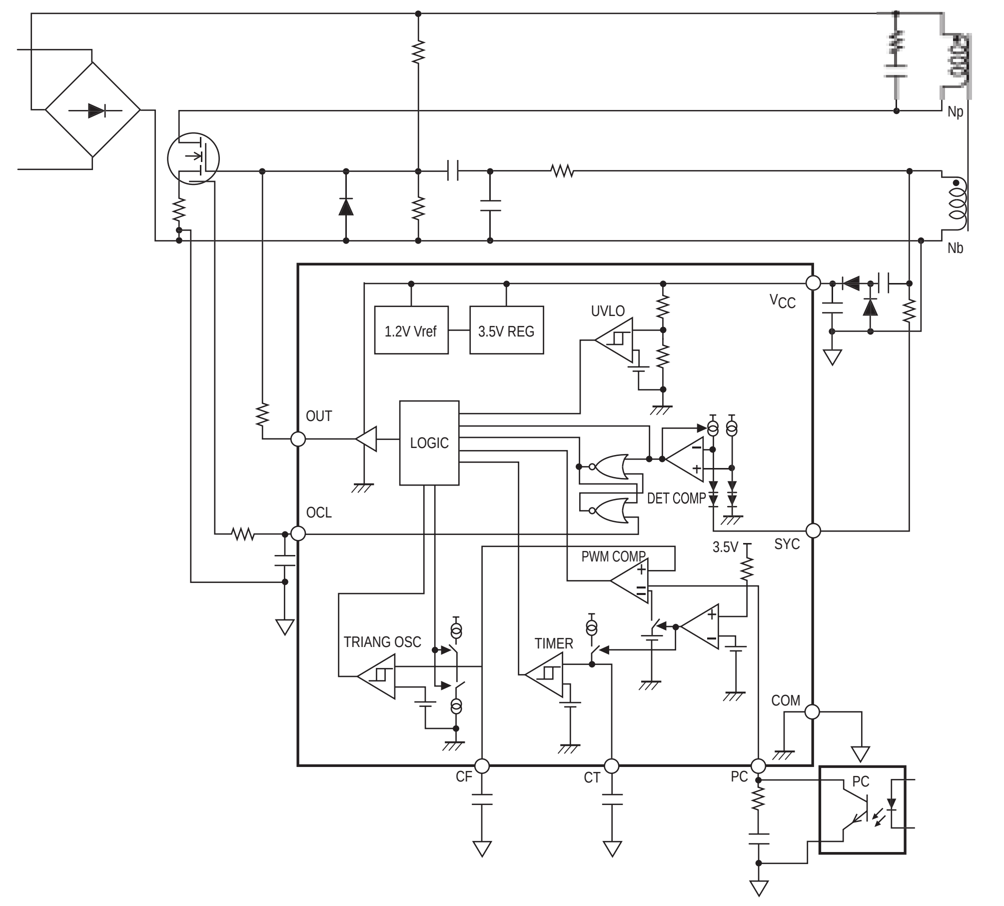


Phase Control Voltage Inverter Control IC

LA5663V

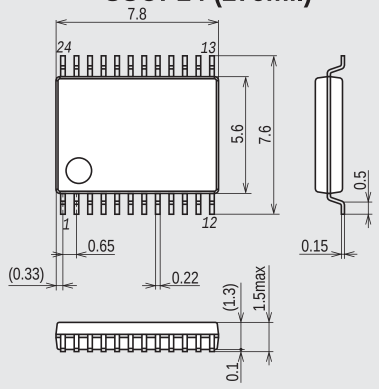
Application

Control of phase control type voltage inverters

Functions/Features

- Phase control technique allows the voltage transformer to be driven at a frequency that provides excellent efficiency.
- The phase can be adjusted with an external resistor.
- Allows burst adjustment.
- Full complement of built-in protection circuits, including overvoltage protection and tube current detection and protection
- High-precision reference voltage system. VREM precision: ±1%
- The on/off state of the VREM circuit can be controlled independently.

SSOP24 (275mil)



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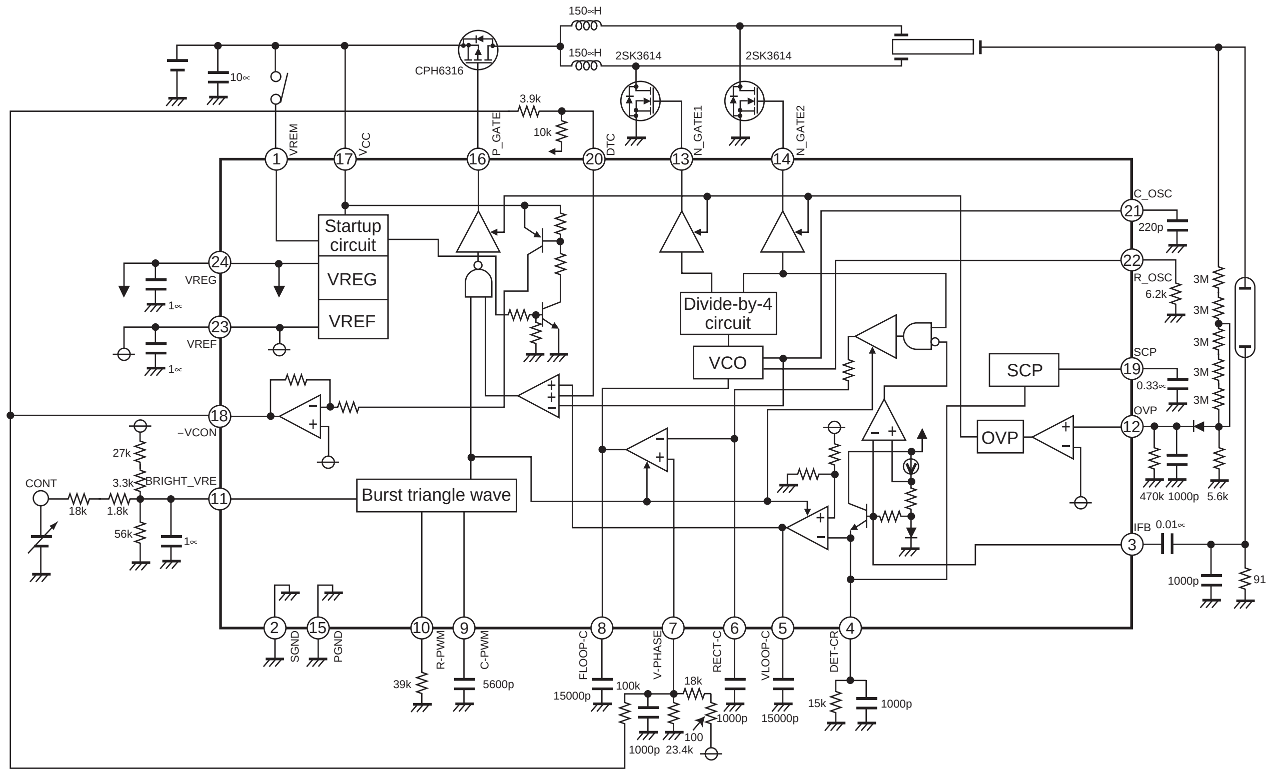


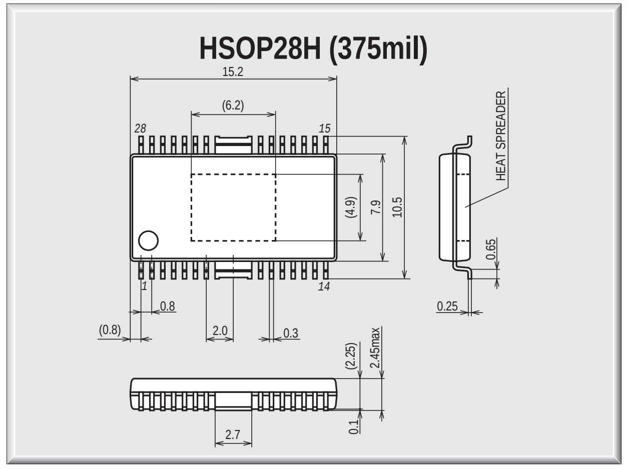
LA5657H

Application

Car audio equipment

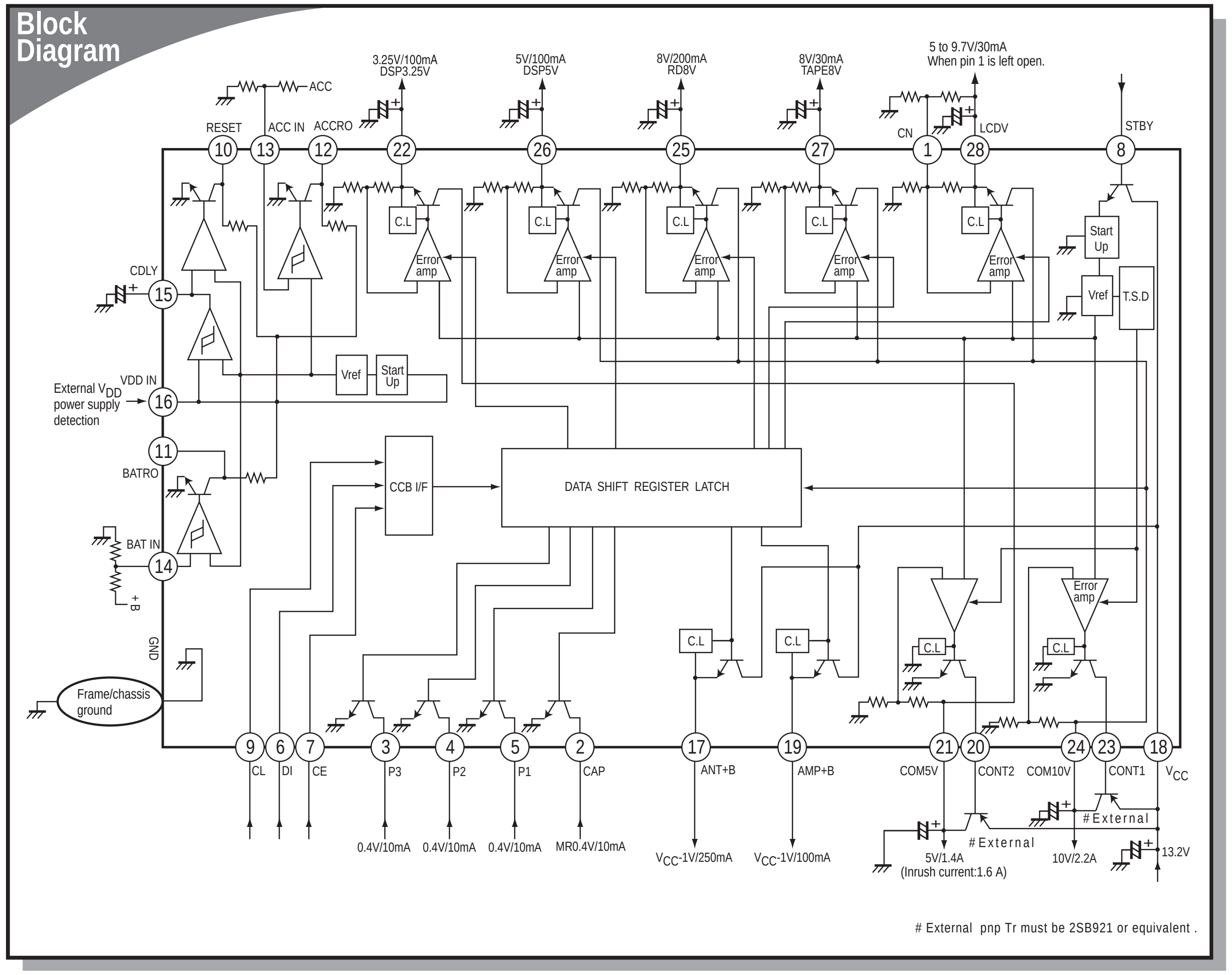
Functions/Features

- 10 V and 5 V regulators (using external pnp transistors) that provide a standby (on/off) function.
- CCB controlled 8 V (two channels), 5 V, 3.25 V, and 5 to 9.7 V (settable with an external resistor) outputs, four open-collector output channels and two channels with V_{CC} linked output
- Three built-in reset systems (A_{CC}, V_{DD} [with delay circuit], and battery)
- Full complement of built-in protection circuits
  ·For outputs other than the open-collector and reset outputs : overcurrent protection
  ·Thermal protection for all outputs except the reset output



HSOP28H (375mil)

Block Diagram



External pnp Tr must be 2SB921 or equivalent .

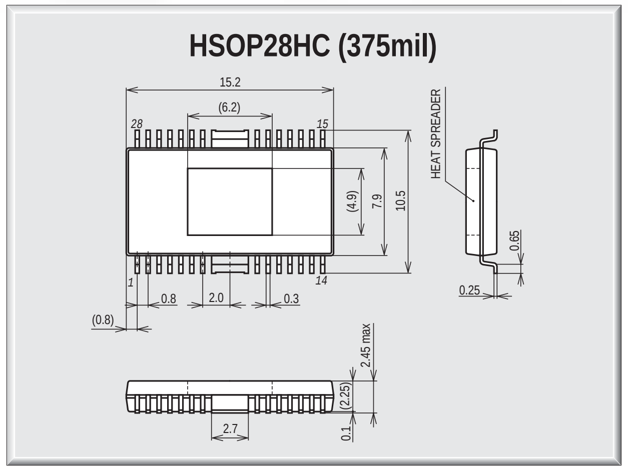
LA5624H

Application

Car audio equipment

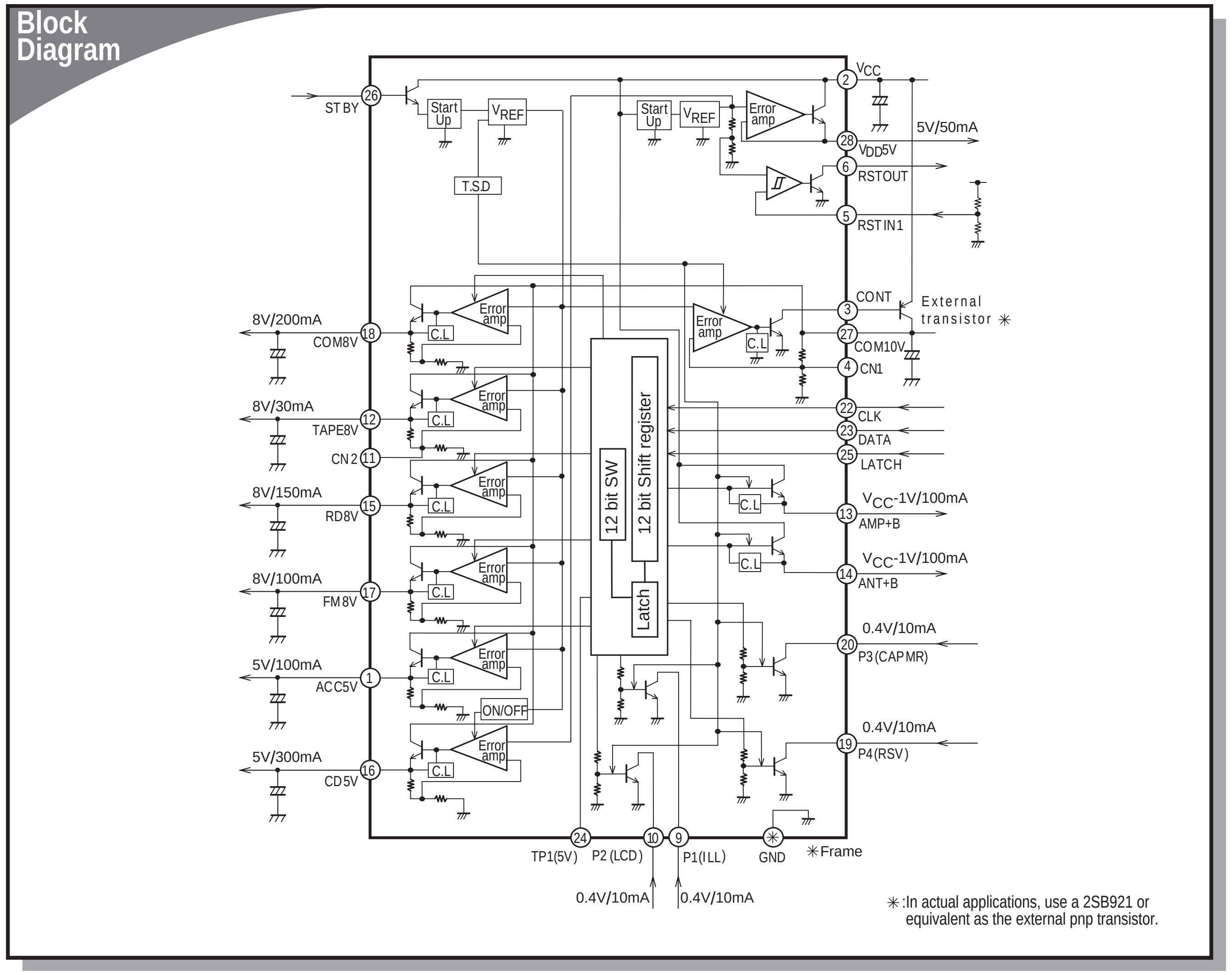
Functions/Features

- 5 V/50 mA regulator
  (always on, built-in reverse current protection)
- With standby (STBY: on/off control) function 10 V/2 A regulator (with external 2SB921 pnp transistor) and 5 V/300 mA regulator
- Multiple regulators with shift register/latch based on/off control (four-output 8 V system, single-output 5 V system), four open-collector output systems, and two emitter-follower output systems
- Full complement of built-in protection circuits
  ·Overcurrent protection for all outputs except the open-collector outputs
  ·Thermal protection for all outputs except the V_{DD} 5 V output



HSOP28HC (375mil)

Block Diagram



✳:In actual applications, use a 2SB921 or equivalent as the external pnp transistor.

System Regulators

LA5601

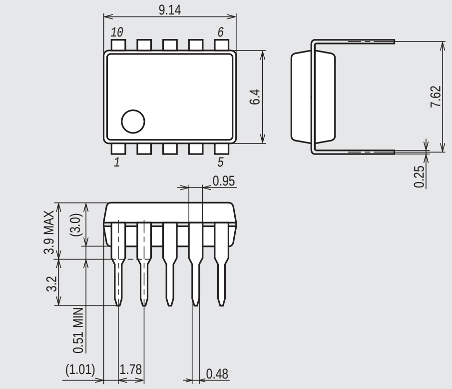
Application

Microcontroller system monitoring power supply
for CD players

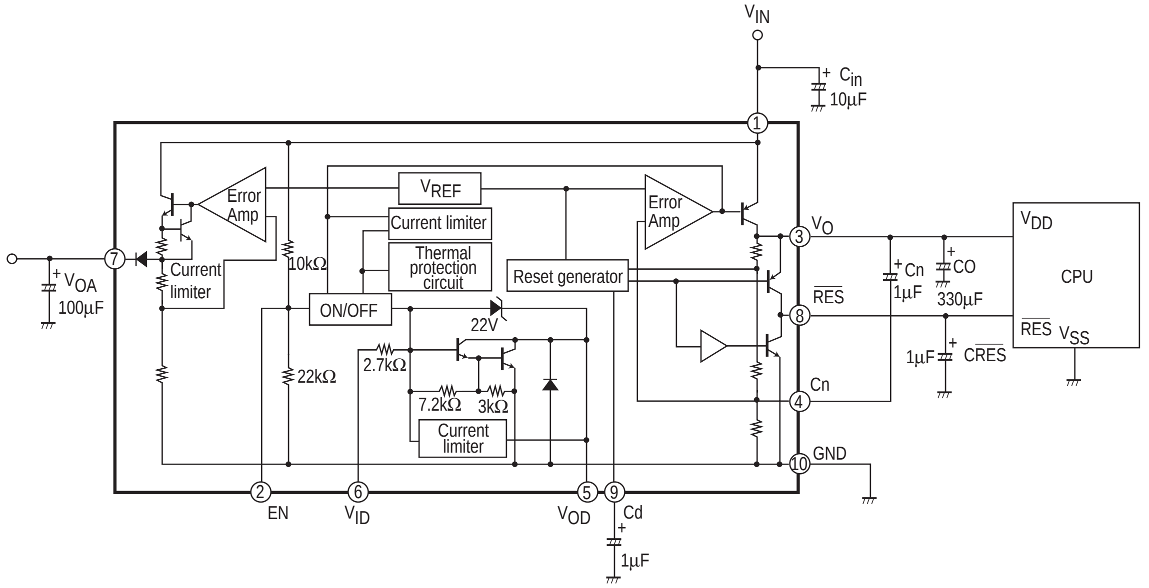
Functions/Features

- Low saturation-voltage regulator (main power supply) : 5.2 V/250 mA
- Generates a power supply reset signal.
- Darlington driver: 120 mA
- Auxiliary power supply: 3.4 V/10 mA
- The main power supply and the driver circuit can be turned on/off at the same time (active high).
- The 5.2 V output features a low minimum I/O voltage difference (0.3 V typical).
- The reset delay time can be set with an external capacitor.
- The driver can be used to generate negative voltages.
- The auxiliary power supply circuit includes a built-in reverse current element diode, and thus is appropriate for use in a backup power supply.

DIP10S (300mil)



Block Diagram



System Regulators

LA5613

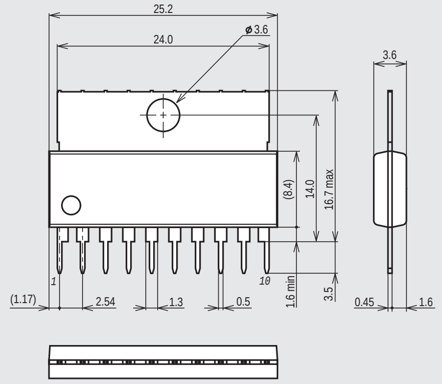
Application

VCRs and other AV equipment

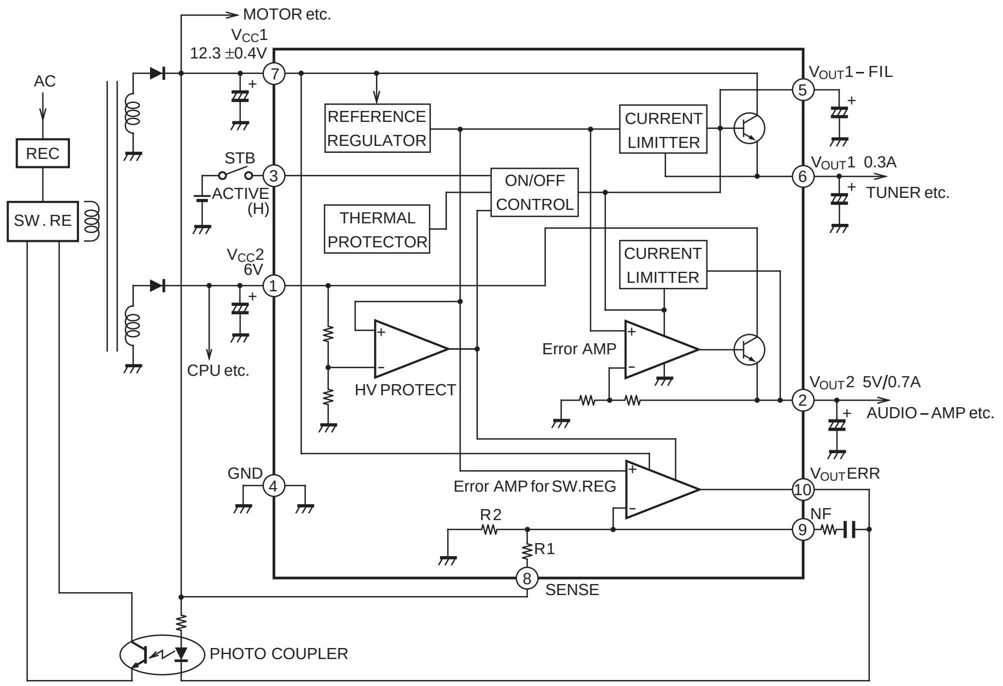
Functions/Features

- 5.0 V/0.7 A low saturation-voltage regulator (with on/off function)
- 11.3V/0.3 A ripple filter
- Switching regulator control amplifier
- Built-in input ($V_{CC}2$) overvoltage and thermal protection circuits
- Thermal protection circuit

SIP10F



Block Diagram



System Regulators

LA5618

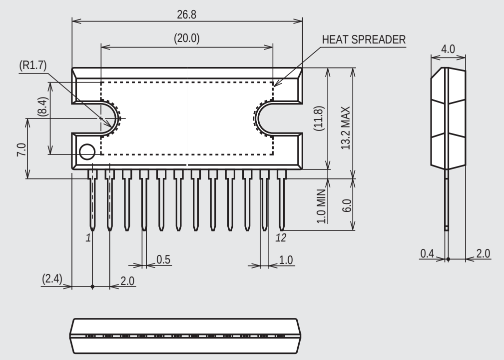
Application

Mini-component stereo systems and other audio equipment

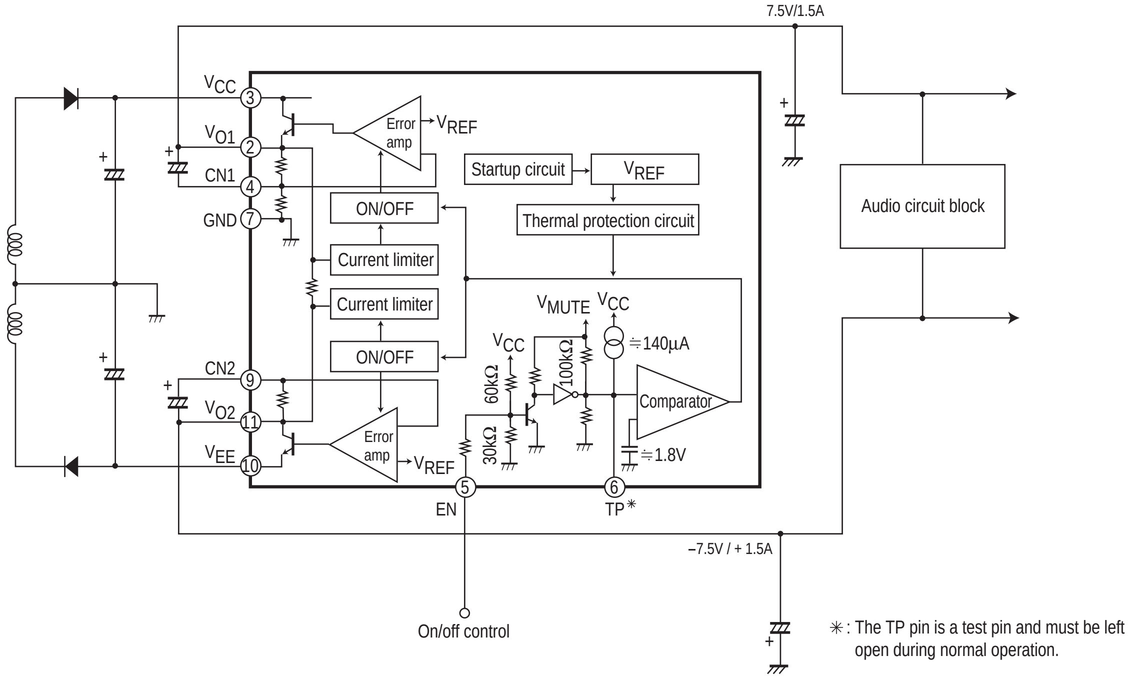
Functions/Features

- Positive and negative voltage tracking regulator : ±7.5 V/±1.5 A (on/off control function)
- System power supplies for microcontroller controlled mini systems
- Sequence control at power on can be implemented easily.
- This device is provided in an SIP-12H package, which allows a higher Pd to be acquired when a heat sink is used.

SIP12H



Block Diagram



✳: The TP pin is a test pin and must be left open during normal operation.

System Regulators

LA5678H

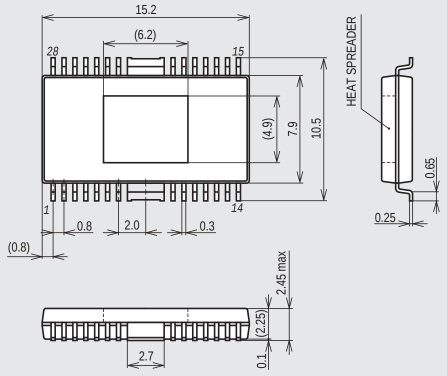
Application

Audio equipment, MD players, and similar products

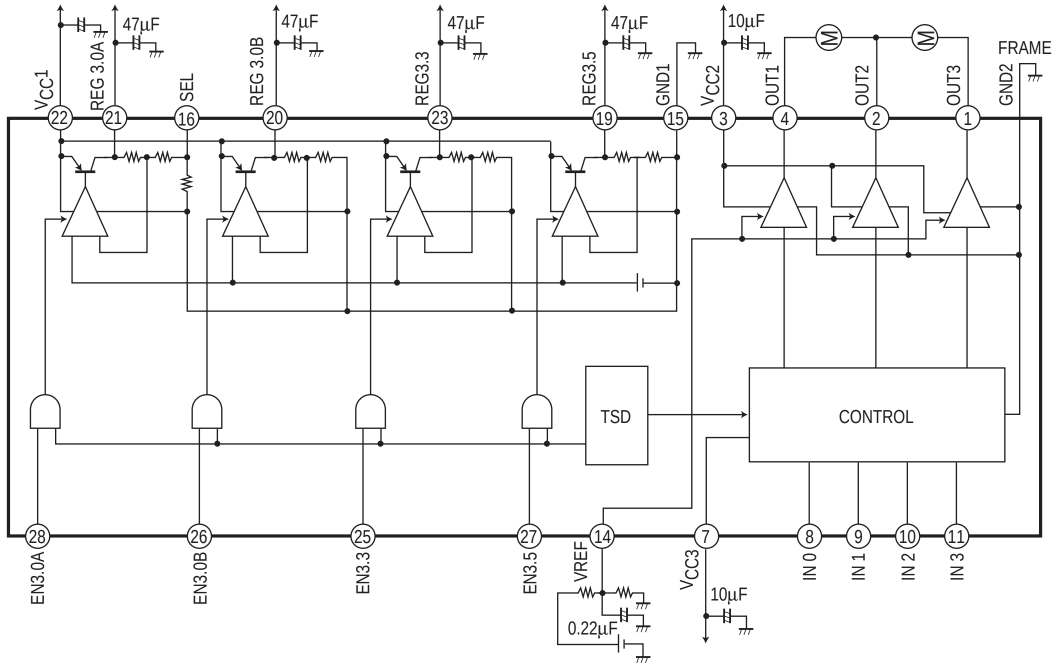
Functions/Features

- Regulator circuit (I_O = 100 mA) that provides a pin for switching between 3.0 and 3.4 V
- One 3.0 V regulator circuit (I_O = 50 mA)
- One 3.3 V regulator circuit (I_O = 150 mA)
- One 3.5 V regulator circuit (I_O = 50 mA)
- The on/off state of each regulator circuit can be controlled independently.
- Built-in 1.5-channel forward/reverse motor driver

HSOP28HC (375mil)



Block Diagram



Three-Terminal Regulators

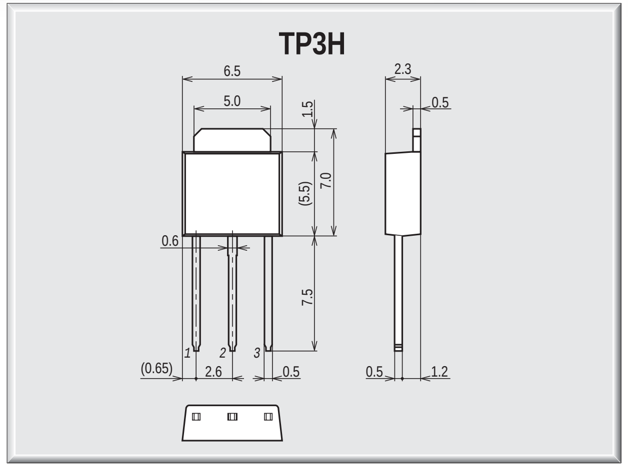
L88M00T

Application

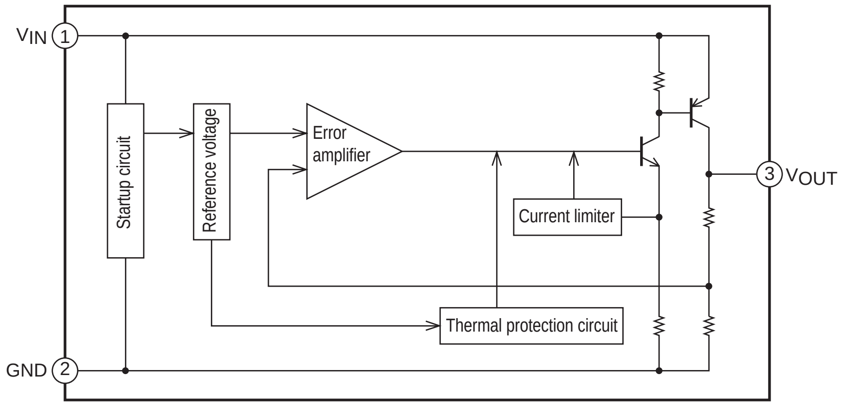
0.5 A low dropout voltage regulator

Functions/Features

- Low dropout voltage regulator
- Output voltages
  L88M18T: 1.8 V, L88M25T: 2.5 V, L88M33T: 3.3 V,
  L88M35T: 3.5 V, L88M05T: 5 V, L88M06T: 6 V,
  L88M09T: 9 V, L88M12T: 12 V
- Output current of 500 mA provided
- Low minimum I/O voltage difference (0.4 V typical) supports energy saving designs and the use of smaller transformers.
- Provided in the TP-3H miniature power package for easy end product miniaturization
- The allowable power dissipation can be increased by surface mounting on a printed circuit board.
- Wide range of formed versions available for mounting flexibility



Block Diagram



Power Supply ICs with Built-in Watchdog Timer Circuits

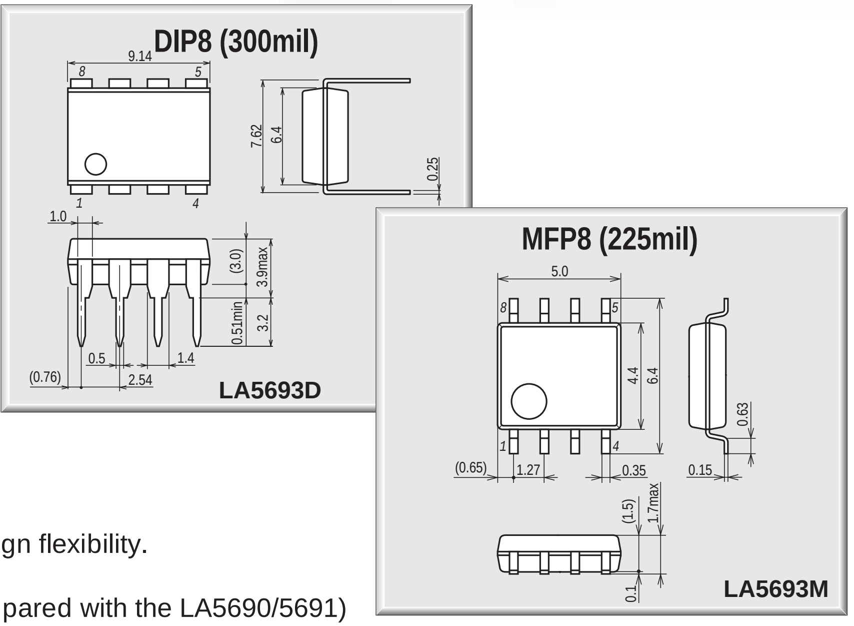
LA5693D/M

Application

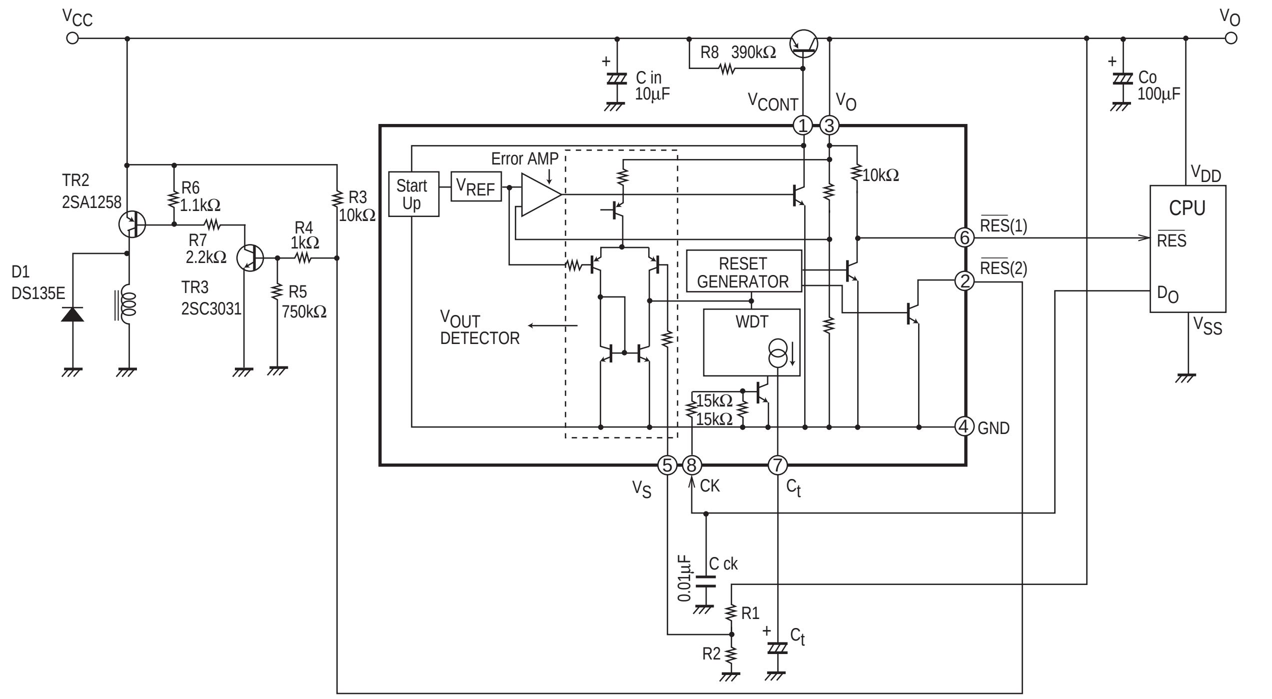
Microcontroller system monitoring in automotive, cooling/heating equipment, and office equipment applications

Functions/Features

- 5 V output voltage power supply controller
- Built-in watchdog timer
- Power supply reset signal generation function
- Two reset/hold outputs
- A low saturation-voltage regulator can be formed by using an external pnp transistor.
- CK input does not contain a built-in edge detection circuit for greater design flexibility.
- Variable reset detection voltage
- Relatively long watchdog time (as compared with the LA5690/5691)
- Built-in 10 kΩ pull-up resistor in the $\overline{RES}$(1) output circuit



Block Diagram



Dual Protection ICs

LA5695M

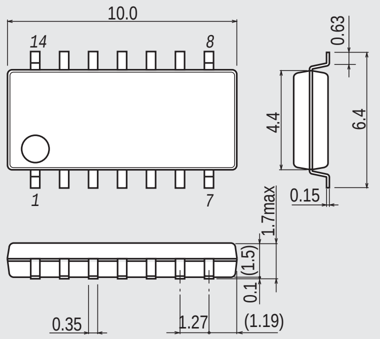
Application

Cooling/heating equipment and office equipment applications

Functions/Features

- Built-in supply voltage abnormality detection circuit
- Driver output with built-in output delay circuit
- Can control using 8 input pins.

MFP14 (225mil)



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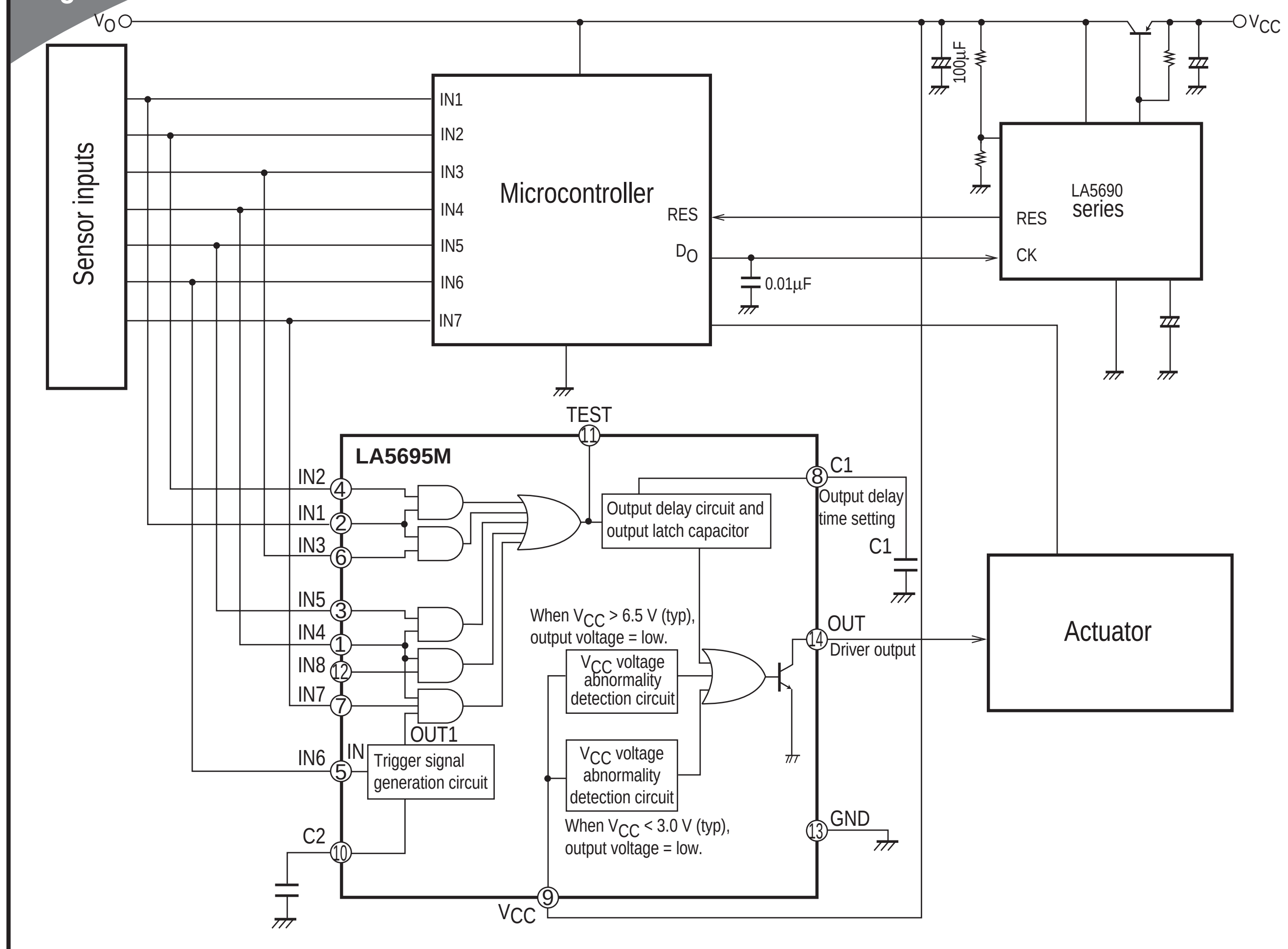


Rechargeable Battery Charge Control ICs

LA5636M

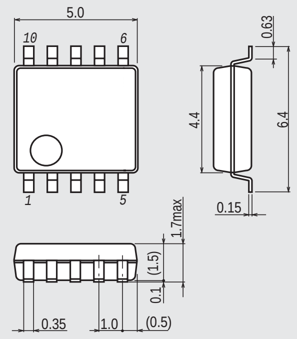
Application

Lithium ion and nickel-metal-hydride battery chargers

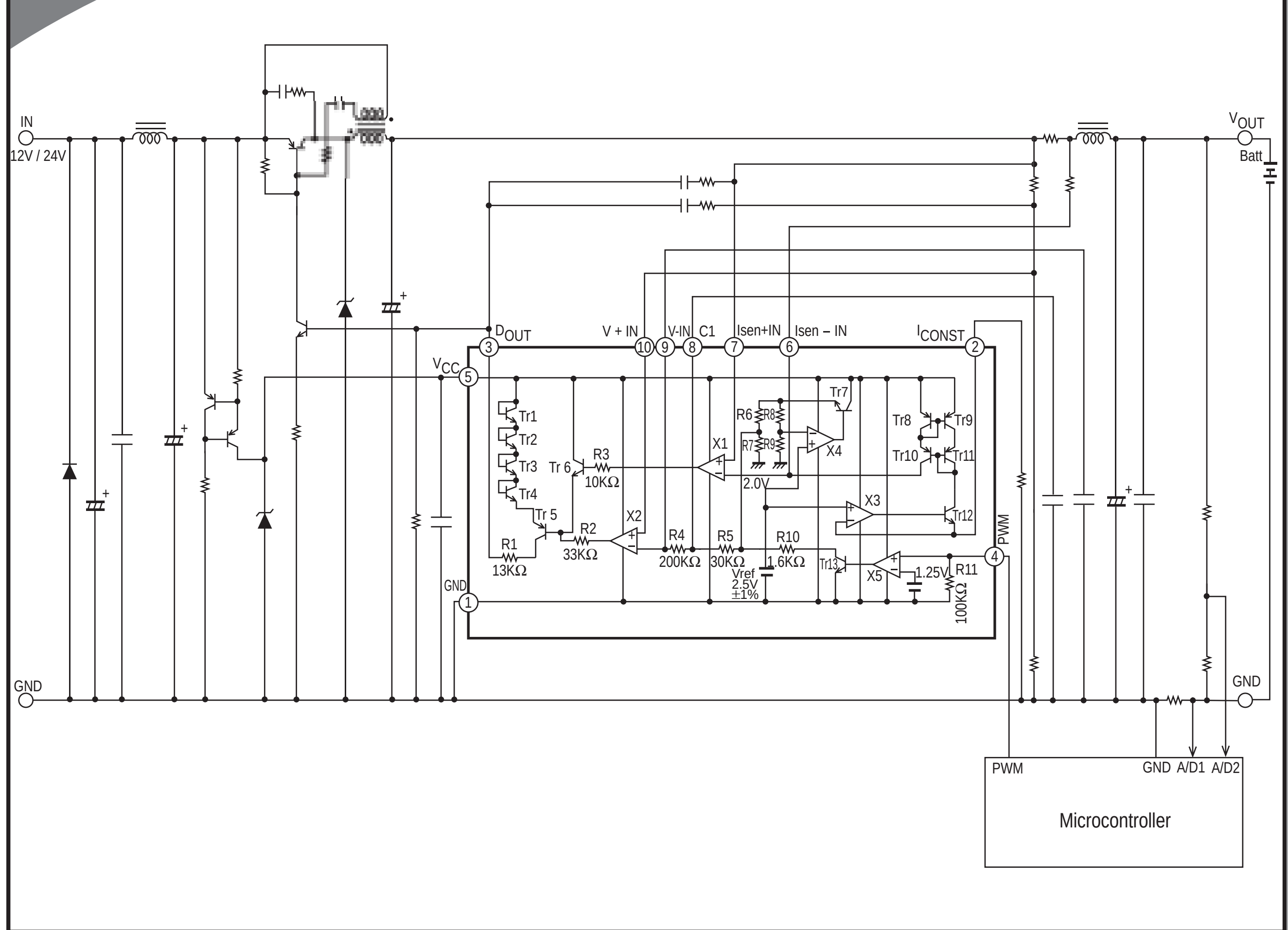
Functions/Features

- Built-in circuit that prevents system malfunctions when the input voltage (car battery voltage) falls.
- Provides a constant voltage output that is proportional to a PWM input signal.(The output voltage can be controlled by the system microcontroller.)
- High-accuracy reference current (current control amplifier): 92.5 µA ±2.7%
- The output voltage can be set with an external resistor.
- Independent voltage and current amplifier loops
- This IC is a DC-DC converter secondary side control IC that uses the automotive power supply (car battery).
- Since this IC provides only the basic functions (constant voltage and constant current control) required in a battery charger IC, it can easily be used together with other battery charger ICs.

MFP10S (225mil)



Block Diagram



Rechargeable Battery Charge Control ICs

LA5614M

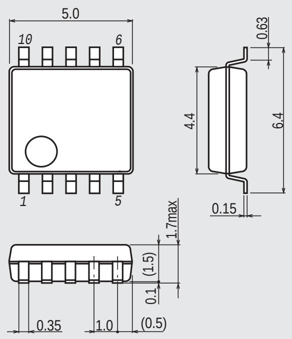
Application

Battery chargers for NiCd and nickel-metal-hydride batteries

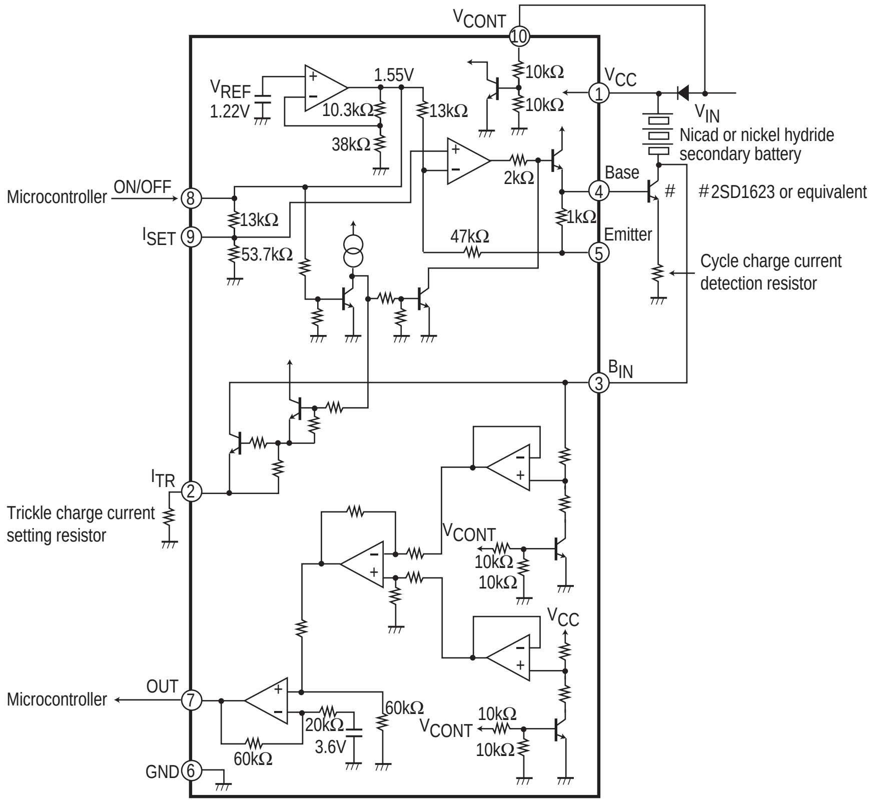
Functions/Features

- External battery transistor drive circuit
- Secondary battery charge voltage detection circuit
- Charge on/off control function
  On: cycle charge, Off: trickle charge
- Cycle charge current setting circuit
- Trickle charge current setting circuit
- For use with Nicad and nickel hydride rechargeable batteries (supports up to 3 cells). Microcontroller charge control (Charging conditions depend on the battery specifications.)
- Supports switching between cycle charge and trickle charge.
- Charge current can be set with an external resistor.

MFP10S (225mil)



Block Diagram



Rechargeable Battery Charge Control ICs

LA5615M/19M

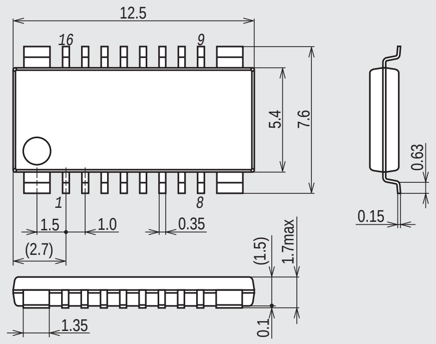
Application

Lead-acid battery charger with battery voltage detection function

Functions/Features

- Secondary battery charging circuit
- Charge current control circuit
  (set with an external resistor: 125 mA typical)
- Circuit for switching between cycle charge and trickle charge (charge current detection level: 40 mA)
  Charge voltage: Cycle charge voltage V_O1=4.6 V,
  trickle charge voltage V_O2=4.9 V
- Battery voltage detection circuit and battery on/off circuit
- Charge on/off circuit
- For secondary lead-acid (SLA) batteries (supports up to 2 cells). Charge characteristics appropriate for lead-acid batteries (Charging conditions can be set according to the battery specifications.)
- The charge voltage is switched when switching between cycle charge and trickle charge.
- LA5619M differs from the LA5615M in that the battery voltage detection circuit has been modified and hysteresis has been added.

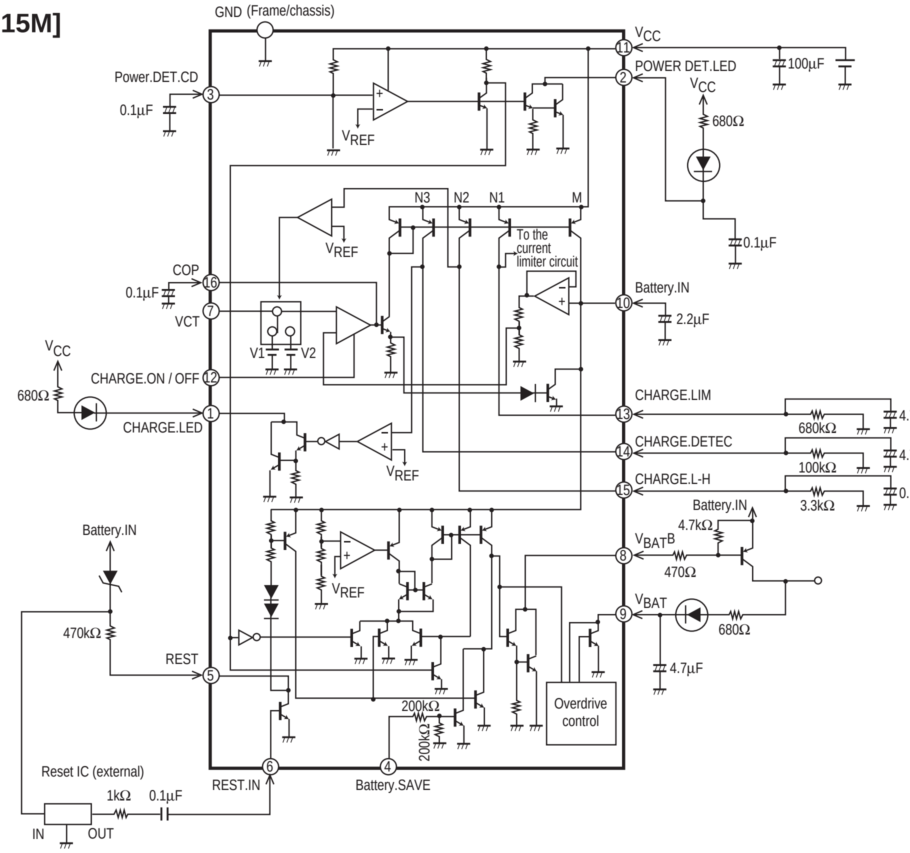
MFP16FS (300mil)



Refer to the data sheet for the LA5619M specifications (Data sheet ordering number:ENN5673)

Block Diagram

[LA5615M]



L88R05

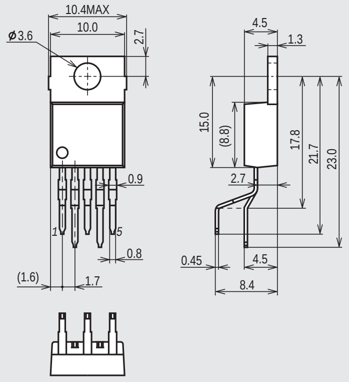
Application

Low saturation-voltage constant voltage power supply with reset function

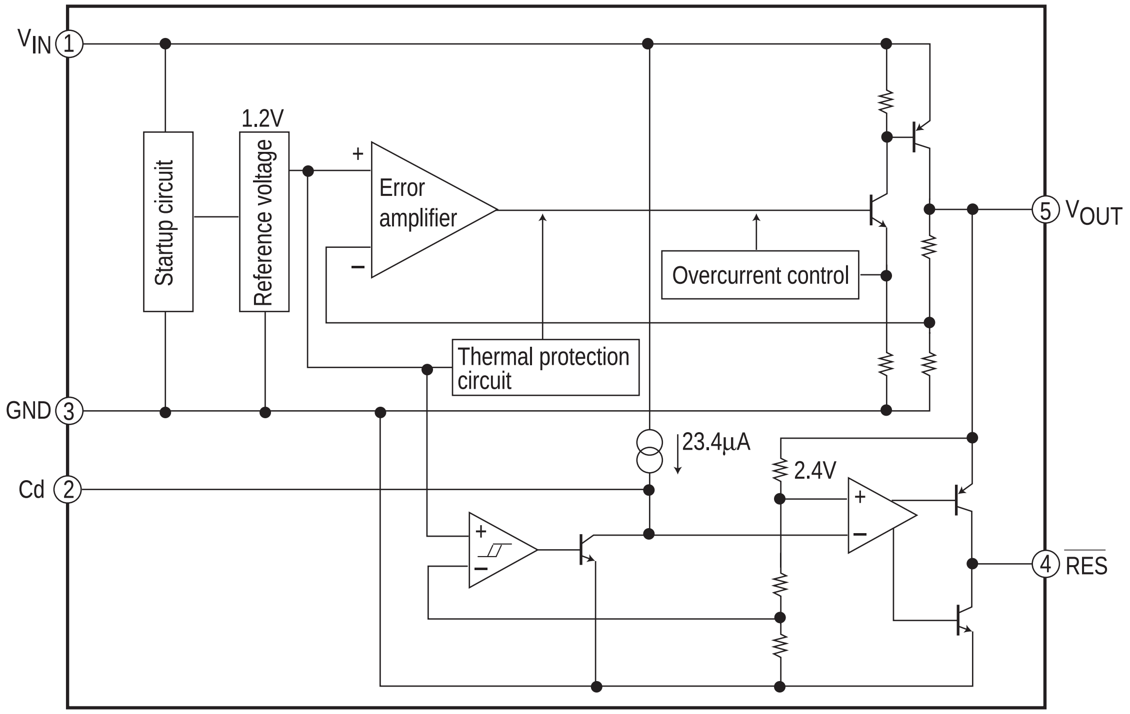
Functions/Features

- Low saturation-voltage regulator: 5 V/1 A
- Microcontroller reset signal generation function
- Full complement of built-in protection circuits
- Low minimum I/O voltage difference (0.5 V typical)
- Three reset threshold voltage rankings provided: C, D, and E
  C: V_{RT} = 4.5 V, D: V_{RT} = 4.2 V, E: V_{RT} = 3.9 V
- Delay time can be set using an external capacitor.
- TO220-5H package adopted for easier mounting and thermal design

TO220-5H



Block Diagram



L78LR05

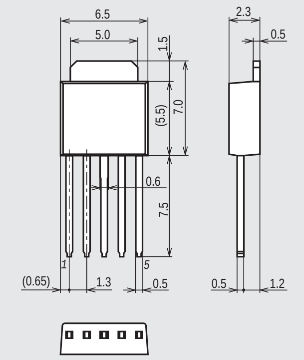
Application

Constant voltage power supply with reset function

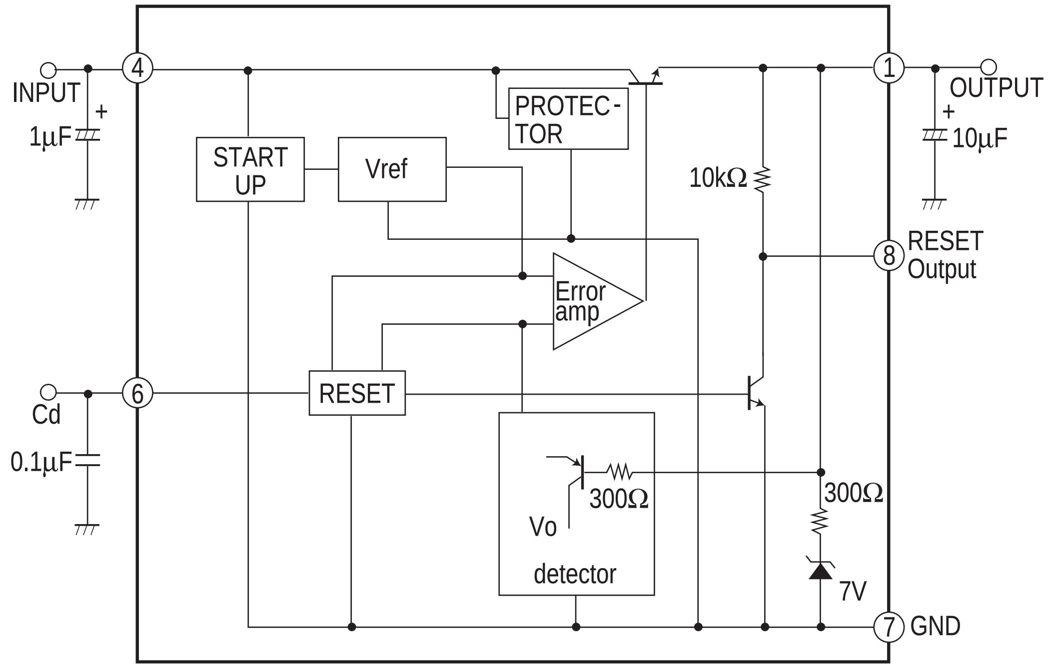
Functions/Features

- Regulator: 5 V/150 mA
- Microcontroller reset signal generation function (Ranked according to the reset threshold voltages V_{RT}) :See page 52(785).
- Battery backup function
- Wide range of V_{RT} rankings to support a variety of microcontrollers
- Delay time can be set using an external capacitor.
- No reverse current prevention diode required for battery backup
- Wide range of formed versions available for mounting flexibility
- Pd can be increased significantly by thermal design when used in surface mounting configuration.

TP5H



Block Diagram



785✳

Application

Constant voltage power supply with reset function

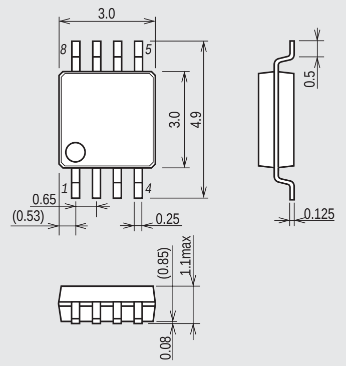
Functions/Features

- Modified package version of the L78LR05
- The table below lists the reset threshold voltages V_{RT} ranking for the 785✳ series products.

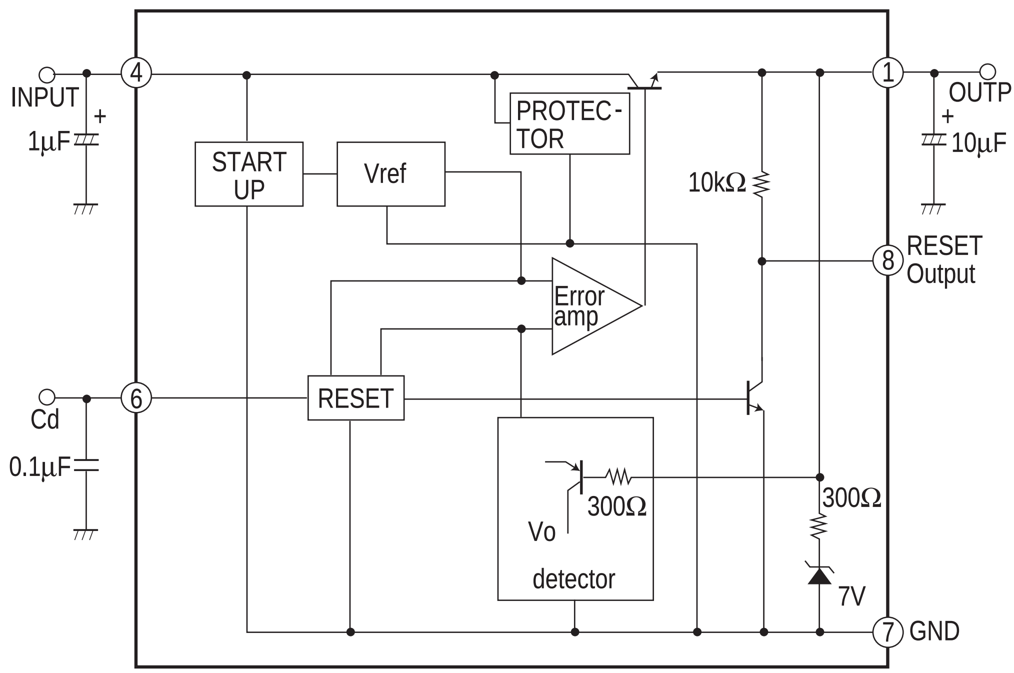
V_{RT} ranking	B	C	D	E	F	G	H
V_{RT}(V)	4.8	4.5	4.2	3.9	3.6	3.3	3.0

◆ Ultraminiature thin form factor package for easier high-density mounting

MSOP8 (150mil)



Block Diagram



L78MR00

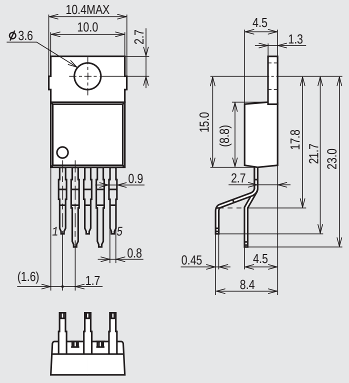
Application

Constant voltage power supply with reset function

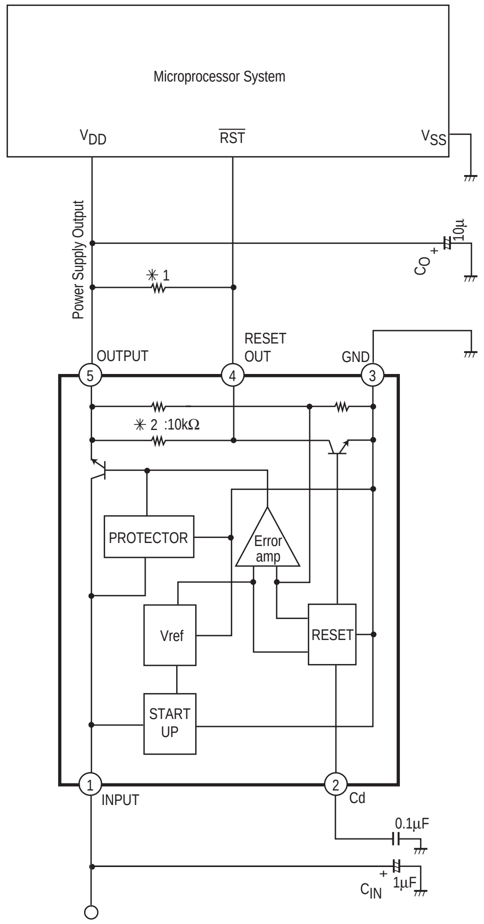
Functions/Features

- Reset (Power supply voltage monitoring : Generates a reset signal at power on and at temporary voltage drops.)
- Output voltages
  L78MR05 : 5V (Reset output: with a built-in pull -up resistor)
  L78MR06 : 6V (Reset output: open collector)
  L78MR08 : 8V (Reset output: open collector)
  L78MR09 : 9V (Reset output: open collector)
  L78MR12 :12V (Reset output: open collector)

TO220-5H



Block Diagram



✳1: The L78MR05 incorporates a built-in 10 kΩ pull-up resistor.
✳2: L78MR05 only

Discrete Devices for Switching Power Supply and Charger

SANYO Discrete Devices

ECoP™ Environmentally Considered Products

Environmentally Considered Products

Overview

SANYO discrete devices are environmentally friendly and can be employed in microprocesses and new processes to make equipment in a wide variety of fields smaller, lower form factor, more efficient and more reliable.

The invisible, user-friendly and smart ECoP® series is based on the concept "light, fast, energy-saving and user-friendly."

Discrete ECoP™ Series
Environmentally Considered Products

Invisible Devices

- Can be used in high-density mounting
- Reduce saturation voltage
- Increase speed

User-friendly Devices

- Increase thermal conductance
- Increase power density
- Increase efficiency

Smart Devices

- Enable incorporation into systems
- Enable modularization
- Enable more advanced functionality

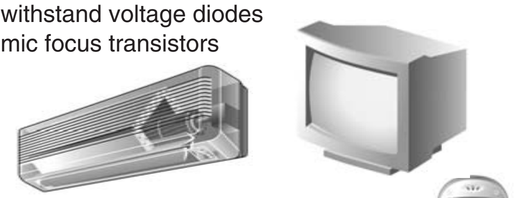
ECoP™ Environmentally Considered Products

Multi-function Devices

- ExPDs
- Si MMICs
- PicoLogic™

Power Devices

- Horizontal deflection output transistors
- High withstand voltage switching transistors
- High withstand voltage Darlington transistors
- High withstand voltage power MOSFETs
- High withstand voltage diodes
- Dynamic focus transistors



High Frequency Devices

- Ultrahigh frequency transistors
- GaAs devices
- Varactor diodes
- JFETs
- PIN diodes
- PicoGET

General-purpose Devices

- High-speed switching transistors
- Switching transistors
- Resistor built-in transistors
- Muting transistors
- Rectifier diodes

Medium-Power Devices

- Ultralow saturation transistors
- Ultralow on-resistance power MOSFETs
- Low VF Schottky barrier diodes
- PicoMOS™
- PicoTR
- PicoSBD™

Discrete Devices for Portable Equipment, PCs and Power Supplies

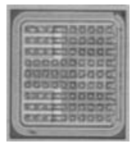
Generation III Low-saturation Transistor MBIT-III

Earlier MBIT

101K cell / inch²

1.4 times greater cell density

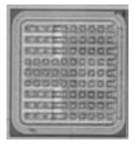
MBIT-II



114K cell / inch²

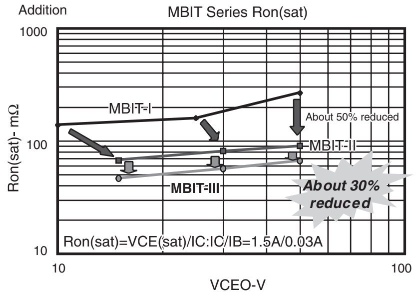
Ultralow-resistance wafer

MBIT-III



114K cell / inch²

■Low saturation of MBIT Series



Pico series Future

■ PicoMOS™ Series Precise Interface Control Series

Low power consumption: Power loss is reduced by 80%

■ PicoTR Series Powerful In Compact Package

While miniature package, it realized low-saturation voltage of the highest performance in the world. 30% reduced as compared to that of the competitors.

■ PicoLogic™ Series Precise Interface Control Series

Can be used for a wide range of power supply line Operation voltage: 3 to 25V (Competitor's products: 20V or less)

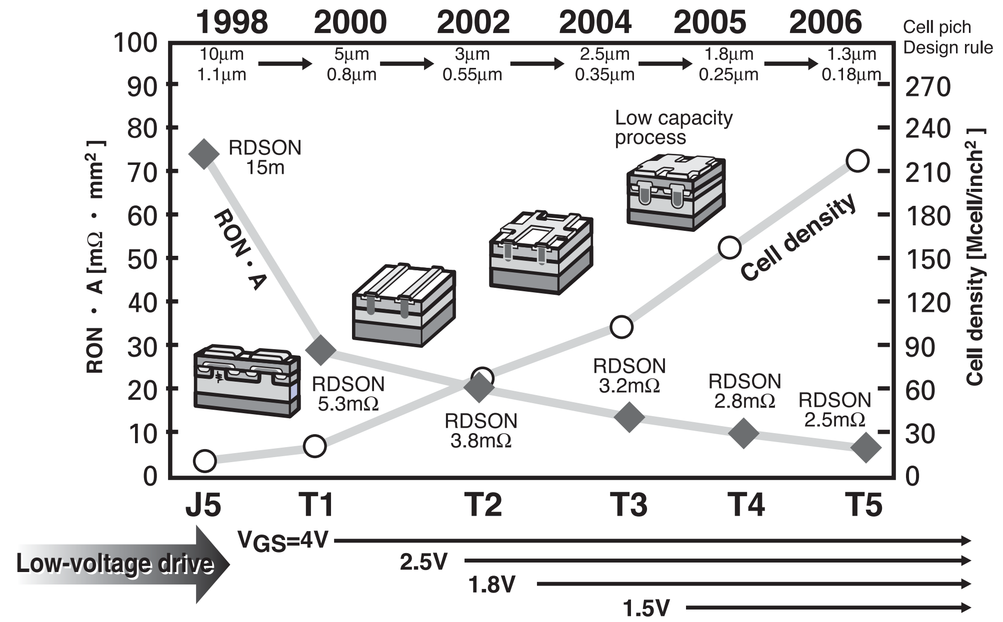
■ PicoSBD™ Series Powerful In Compact Package

While miniature package, it achieves low VF characteristic of the highest performance in the world. 30% reduced as compared to that of the competitors.

■ PicoGET Series Prominent chip In Compact package
GHz Efficient Transistor

Able to be used for general-purpose high frequency equipments for switching and amplification.

Ultra-low on Resistance Power MOSFET Generations

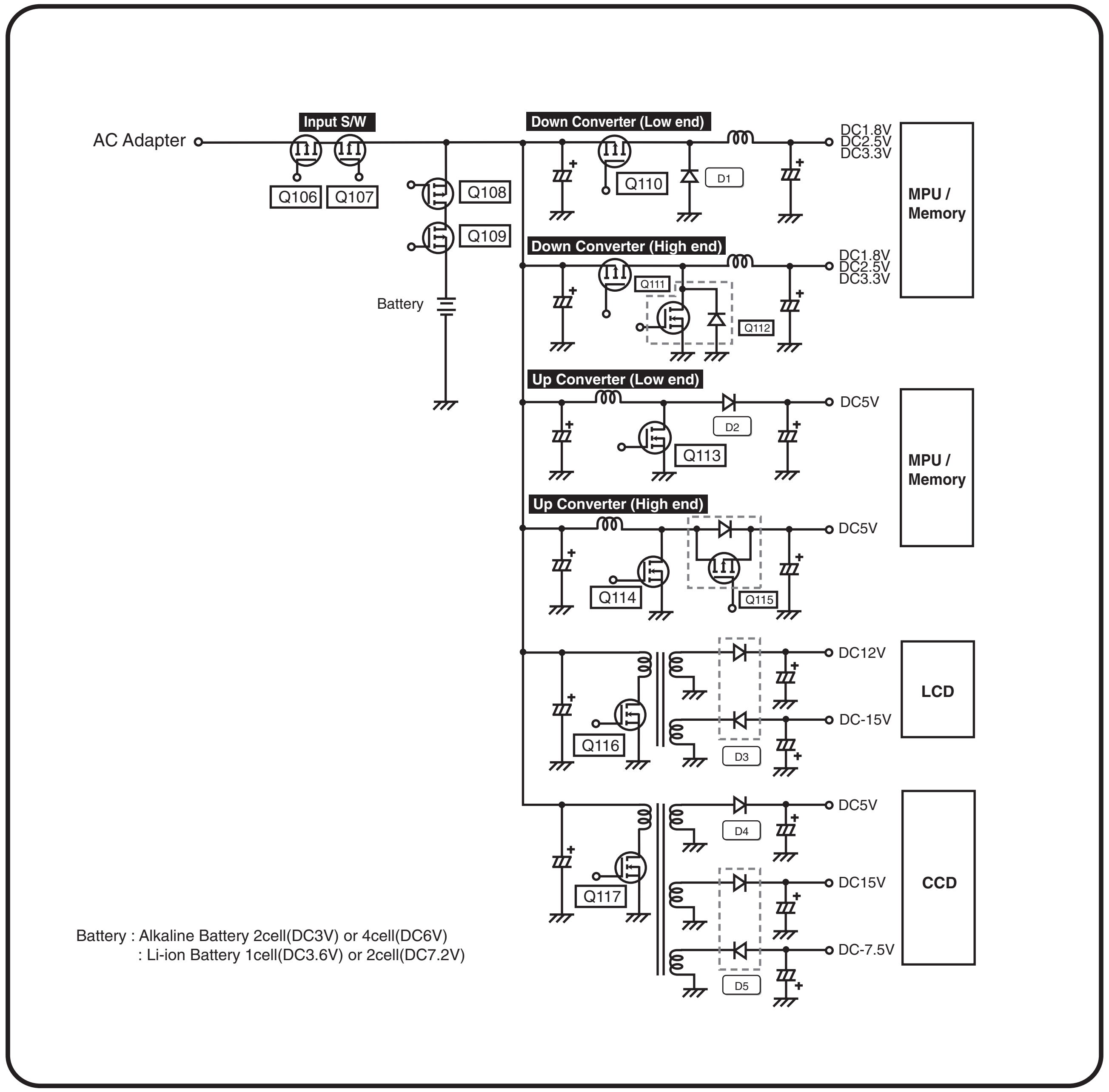


Mounting Comparison for ECoP™ Packages

	ECSP-1008	SSFP	New SCH6	MCP	MCPH6	CPH6	New ECH8	New VEC8	TSSOP8	SOP8
Size (mm)	1.0×0.8	1.4×1.4	1.6×1.6	2.1×2.0	2.1×2.0	2.8×2.9	2.8×2.9	2.8×2.9	3.0×6.4	6.0×5.0
Footprint (mm²)	0.8	1.96	2.56	4.2	4.2	8.12	8.12	8.12	19.2	30
h (mm)	0.6	0.6	0.56	0.9	0.85	0.9	0.85	0.75	1.0	1.8
P$_D$ (W)	0.15	0.15	0.8	0.15	1.5	1.6	1.6	1.5	1.8	2.9

Power Management SW Devices for DC/DC Converters

■ Application Example



Battery : Alkaline Battery 2cell(DC3V) or 4cell(DC6V)
: Li-ion Battery 1cell(DC3.6V) or 2cell(DC7.2V)

■ Input S/W

MOSFETs

Type No.	Package	Polarity	V_{DSS} (V)	I_D (A)	R_{DS}(on)(mΩ)								Ciss typ (pF)	Qg typ (nC)	
					V_{GS}=4.5V		V_{GS}=4V		V_{GS}=2.5V		V_{GS}=1.8V				
					typ	max	typ	max	typ	max	typ	max			
ECH8611	ECH8	Pch×2	12	5	30	40	-	-	45	65	66	95	1230	12	Q106 to Q109
FTD7003	TSSOP8	Pch×2	12	6	20	25	-	-	29	40	40	60	2100	28	
ECH8301	ECH8	Pch	20	8	-	-	18	24	26	37	-	-	1700	21	
ECH8603	ECH8	Pch×2	20	4	37	54	-	-	58	87	-	-	800	21	
2SJ613	PCP	Pch	20	6	-	-	53	69	72	98	-	-	680	7.8	

Power Management SW Devices for DC/DC Converters

■ Down Converter

MOSFETs

Type No.	Package	Polarity	V_{DSS} (V)	I_D (A)	R_{DS}(on)(mΩ)				Ciss typ (pF)	Qg typ (nC)	
					V_{GS}=4V		V_{GS}=2.5V				
					typ	max	typ	max			
MCH3309	MCPH3	Pch	20	1.5	180	235	240	340	290	3.2	Q110/Q111
CPH3313	CPH3		20	1.6	180	235	240	340	290	3.2	

Low Saturation Voltage Transistors

Type No.	Package	Polarity	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	I_{CP} (A)	h_{FE}				V_{CE}(sat)(mV)				
							V_{CE} (V)	I_C (mA)	min	max	I_C (A)	I_B (mA)	typ	max	
CPH3235	MCPH3	PNP	15	12	3	5	2	500	200	560	1.5	30	110	165	Q110/Q111
MCH3143	MCPH3	PNP	15	12	2.5	5	2	100	200	560	1	50	90	135	

Complex Devices (MOSFET + Schottky Barrier Diode)

Type No.	Package	Polarity	Rower MOSFET										SBD						Composition	
			V_{DSS} (V)	I_D (A)	R_{DS}(on)(mΩ)						Ciss (pF)	Qg Typ (nC)	V_{RRM} (V)	I_O (A)	V_F		I_R			
					V_{GS}=4V		V_{GS}=2.5V		V_{GS}=1.8V						I_F (A)	max (V)	V_R (V)	max (μ)		
					Typ	max	Typ	max	Typ	max										
MCH5801	MCPH5	Nch	20	1.5	160	210	200	280	280	390	100	4.5	15	0.5	0.3	0.40	6	200	MCH3405+SB07/03C	Q112
SCH2816	SCH6	Nch	20	1.6	310	440	*120	160	-	-	77	2.9	15	0.5	0.5	0.44	6	90	SCH1416+SS05015	

Complex Devices (Transistor + Schottky Barrier Diode)

Type No.	Package	Polarity	TR				SBD						Composition	
			V_{CBO} (V)	V_{CEO} (V)	I_C (A)	I_{CP} (A)	V_{RRM} (V)	I_O (A)	V_F		I_R			
									I_F (mA)	max (V)	V_R (V)	max (μ)		
MCH6731	MCPH6	PNP	15	12	1.0	2.0	15	0.5	500	0.45	6	90	12A02MH+SBS018	Q110+D1
CPH5701	CPH5	PNP	15	15	3	5	15	1	500	0.35	6	200	CPH3106+SBS004	
CPH6702	CPH6	PNP	15	15	1.5	3	30	0.5	300	0.4	10	200	CPH3114+SBS006	
MCH6702	MCPH6	PNP	15	15	1.5	3	30	0.7	300	0.4	10	200	MCH6101+SBS006	

■ Up Converter & Other Converter

MOSFETs

Type No.	Package	Polarity	V_{DSS} (V)	I_D (A)	R_{DS}(on)(mΩ)				Ciss typ (pF)	Qg typ (nC)	
					V_{GS}=4V		V_{GS}=2.5V				
					typ	max	typ	max			
CPH3413	CPH3	Nch	20	2.2	100	130	130	180	190	2.7	Q113/Q114
MCH3409	MCPH3	Nch	20	2.0	100	130	130	180	190	2.7	Q116/Q117
MCH6305	MCPH6	Pch	20	4	50	65	72	98	680	8.7	Q115

Complex Device (MOSFET + Schottky Barrier Diode)

Type No.	Package	Rower MOSFET										SBD							Composition	
		V_{DSS} (V)	I_D (A)	R_{DS}(on)(mΩ)						Ciss (pF)	Qg Typ (nC)	V_{RRM} (V)	I_O (A)	V_F			I_R			
				V_{GS}=4V		V_{GS}=2.5V		V_{GS}=1.8V						I_F (A)	typ (V)	max (V)	V_R (V)	max (μ)		
				Typ	max	Typ	max	Typ	max											
CPH5802	CPH5	20	2	110	145	140	200	180	260	410	10	15	1	0.5	0.3	0.35	6	500	MCH3306+SBS004	Q115

Complex Devices (Transistor + Schottky Barrier Diode)

Type No.	Package	Polarity	TR				SBD						Composition	
			V_{CBO} (V)	V_{CEO} (V)	I_C (A)	I_{CP} (A)	V_{RRM} (V)	I_O (A)	V_F		I_R			
									I_F (mA)	max (V)	V_R (V)	max (μA)		
MCH5702	MCPH5	NPN	15	15	1.5	3	30	0.7	300	0.4	10	200	MCH6201+SBS006	Q113+D2
MCH6732	MCPH6	NPN	20	15	1	2	15	0.5	500	0.45	6	90	15C02MH+SBS018	

Schottky Barrier Diodes

Type No.	Package	V_{RRM} (V)	I_O (A)	I_{FSM} (A)	V_F1		V_F2		I_R		trr max (nS)	
					I_F (A)	max (V)	I_F (A)	max (V)	V_R (V)	max (V)		
SBS004M	MCPH3	15	1	10	0.5	0.35	1	0.4	6	500	15	D1/D2/D4
SS10015M	MCPH3	15	1	10	0.3	0.32	0.5	0.35	6	90	10	
SS1003EJ	ECSP1608-4	30	1	5	0.5	0.39	1	0.45	15	360	10	
SS1003M	MCPH6	30	1	10	0.5	0.39	1	0.45	15	360	10	
SBE803	CPH5	90	0.2	5	0.2	0.7	-	-	45	50	10	D3/D5

Small Signal Swiches Transistors

Ultra-low Saturation Voltage Transistors

Type No.	Package	Polarity	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	I_{CP} (A)	h_{FE}				V_{CE}(sat)(mV)			
							V_{CE} (V)	I_C (mA)	min	max	I_C (A)	I_B (mA)	typ	max
EC3202C	ECSP1008-4	NPN	25	15	0.1	0.2	2	5	800	3200	0.01	1	14	30
EC3101C	ECSP1008-4	PNP	50	50	0.15	0.3	6	1	200	600	0.05	5	120	400
EC3201C	ECSP1008-4	NPN	55	50	0.15	0.3	6	1	800	3200	0.05	5	80	400

PicoMOS™ Series

Type No.	Package	Polarity	V_{DSS} (V)	I_D (A)	R_{DS}(on)(Ω)								Ciss (pF)	Qg typ (nC)
					V_{GS}=10V		V_{GS}=4V		V_{GS}=2.5V		V_{GS}=1.5V			
					typ	max	typ	max	typ	max	typ	max		
EC4301C	ECSP1008-4	Pch	30	0.1	-	-	8	10.4	11	15.4	27	54	7.5	1.43
EC4401C	ECSP1008-4	Nch	30	0.15	-	-	2.9	3.7	3.7	5.2	6.4	12.8	7.0	1.58
EC4304C	ECSP1008-4	Pch	30	0.25	-	-	1.5	1.9	2.0	2.8	4.0	8.0	40	0.8
EC4404C	ECSP1008-4	Nch	30	0.35	-	-	0.7	0.9	0.8	1.15	1.6	2.4	30	1.0
EC4302C	ECSP1008-4	Pch	50	0.07	-	-	18	23	20	28	30	60	7.4	1.4
EC4303C	ECSP1008-4	Pch	50	0.07	17	22	23	32	-	-	-	-	6.2	1.32
EC4402C	ECSP1008-4	Nch	50	0.1	-	-	6	7.8	7.1	9.9	10	20	6.6	1.57
EC4403C	ECSP1008-4	Nch	50	0.1	5.8	7.5	7.5	10.5	-	-	-	-	6.2	1.4

Schottky Barrier Diodes

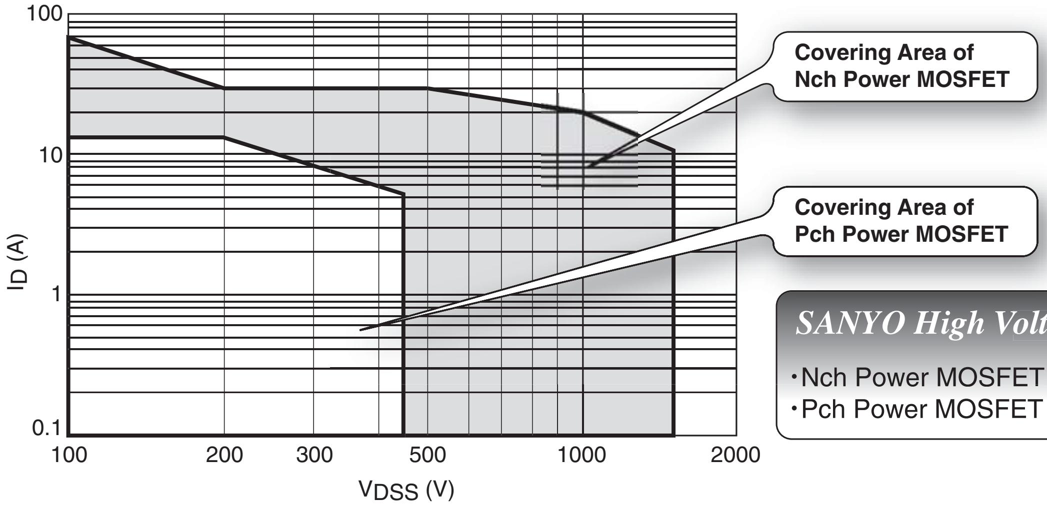
Type No.	Package	V_{RRM} (V)	I_O (A)	I_{FSM} (A)	V_F1		V_F2		I_R		trr max (nS)	Composition
					I_F (A)	max (V)	I_F (A)	max (V)	V_R (V)	max (V)		
EC2D01B	ECSP1006-2	30	0.07	2	0.07	0.65	-	-	15	5	10	Power-Supplies LCD-Inverter etc
EC2D02B	ECSP1006-2	30	0.1	2	0.05	0.40	0.1	0.48	15	100	10	Power-Supplies LCD-Inverter etc
SB0203EJ	ECSP1608-4	30	0.2	2	0.2	0.55	-	-	15	5	10	Power-Supplies LCD-Inverter etc
SS0203EJ	ECSP1608-4	30	0.2	2	0.2	0.45	-	-	15	200	10	Power-Supplies LCD-Inverter etc
SB0503EJ	ECSP1608-4	30	0.5	5	0.5	0.55	-	-	15	15	10	Power-Supplies LCD-Inverter etc
SS0503EJ	ECSP1608-4	30	0.5	5	0.5	0.45	-	-	15	360	10	Power-Supplies LCD-Inverter etc
SB02-03Q	MCP	30	0.2	2	0.2	0.55	-	-	15	15	10	Power-Supplies LCD-Inverter etc
SB007W03Q	MCP	30	0.07	2	0.07	0.55	-	-	15	5	10	Power-Supplies LCD-Inverter etc
SB007-03Q	MCP	30	0.07	2	0.07	0.55	-	-	15	5	10	Power-Supplies LCD-Inverter etc
SB02W03C	CP	30	0.2	2	0.2	0.5	-	-	15	15	10	Power-Supplies LCD-Inverter etc
SB01-05Q	MCP	50	0.1	2	0.1	0.55	-	-	25	15	10	Power-Supplies LCD-Inverter etc
SB01-05CP	CP	50	0.1	2	0.1	0.55	-	-	25	15	10	Power-Supplies LCD-Inverter etc
SB05W05C	CP	50	0.5	5	0.5	0.55	-	-	25	50	10	Power-Supplies LCD-Inverter etc

PicoTR Series

Type No.	Package	Polarity	V_{CBO} (V)	V_{CEO} (V)	I_C (mA)	h_{FE}				V_{CE}(sat)(mV)			
						V_{CE} (V)	I_C (mA)	min	max	I_C (mA)	I_B (mA)	typ	max
30A01SS	SSFP	PNP	30	30	300	2	10	200	500	100	5	110	220
30A02SS	SSFP	PNP	30	30	600	2	10	200	500	200	10	110	220
30A01S	SMCP	PNP	30	30	300	2	10	200	500	100	5	110	220
30A02S	SMCP	PNP	30	30	600	2	10	200	500	200	10	110	220
30A01M	MCP	PNP	30	30	300	2	10	200	500	100	5	110	220
30A02MH	MCPH3	PNP	30	30	700	2	10	200	500	200	10	110	220
30C01SS	SSFP	NPN	40	30	400	2	10	300	800	100	5	100	200
30C02SS	SSFP	NPN	40	30	600	2	50	300	800	200	10	110	220
30C01S	SMCP	NPN	40	30	400	2	10	300	800	100	5	100	200
30C02S	SMCP	NPN	40	30	600	2	50	300	800	200	10	85	190
30C01M	MCP	NPN	40	30	400	2	10	300	800	100	5	100	200
30C02MH	MCPH3	NPN	40	30	700	2	50	300	800	200	10	85	190

High Withstand Voltage Power MOSFET series

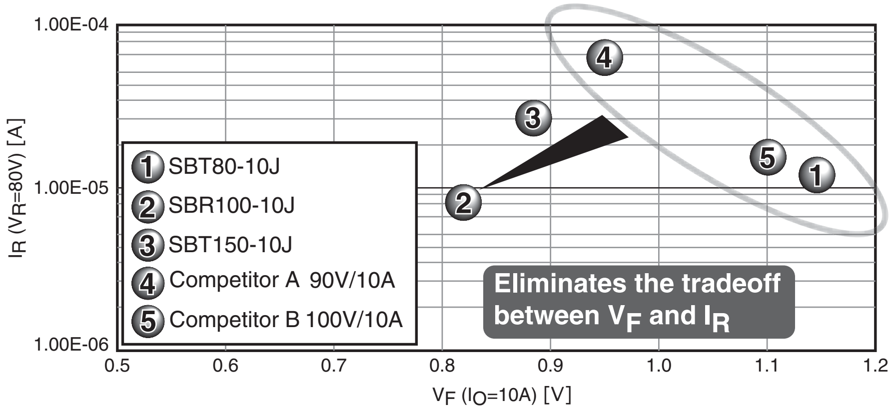
High Voltage Power MOSFET



SANYO High Voltage Technology

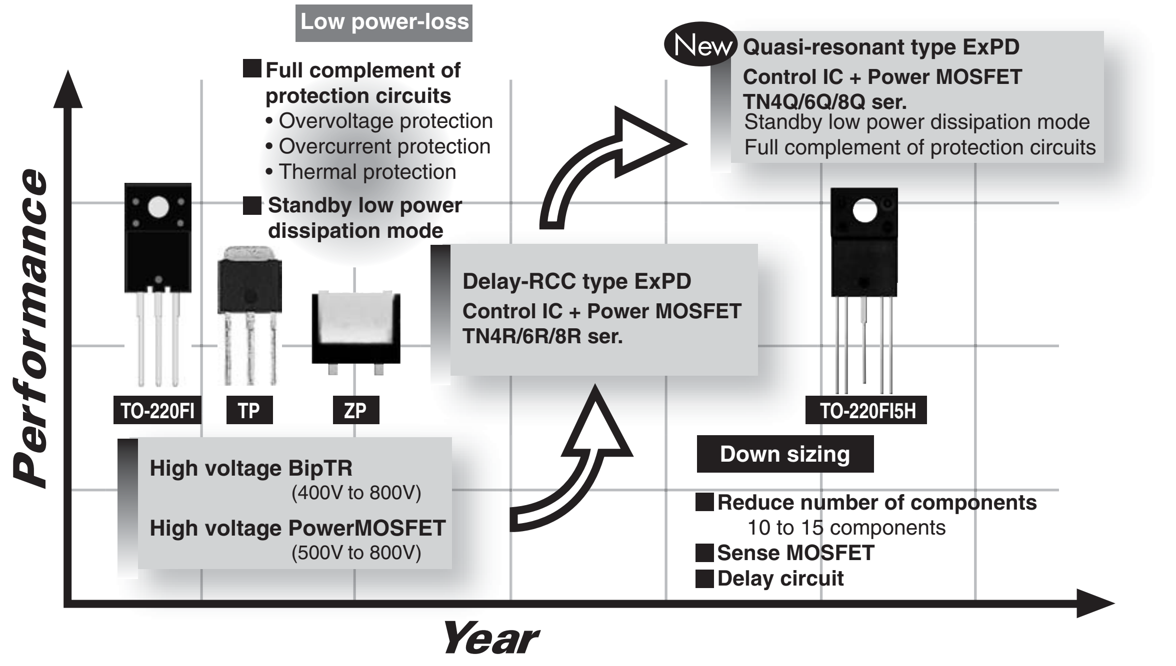
- Nch Power MOSFET : to 1500V/10A type
- Pch Power MOSFET : to 450V/5A type

Power Schottky Barrier Diodes (for Large-Signal Ues)



The SBR series are breakthrough products that reduce both V_F loss when charging and reverse power loss during high-temperature operation.

Switching Regulator IC for Power Supplies



- **Full complement of protection circuits**
  - Overvoltage protection
  - Overcurrent protection
  - Thermal protection
- **Standby low power dissipation mode**

Quasi-resonant type ExPD
Control IC + Power MOSFET
TN4Q/6Q/8Q ser.
Standby low power dissipation mode
Full complement of protection circuits

Delay-RCC type ExPD
Control IC + Power MOSFET
TN4R/6R/8R ser.

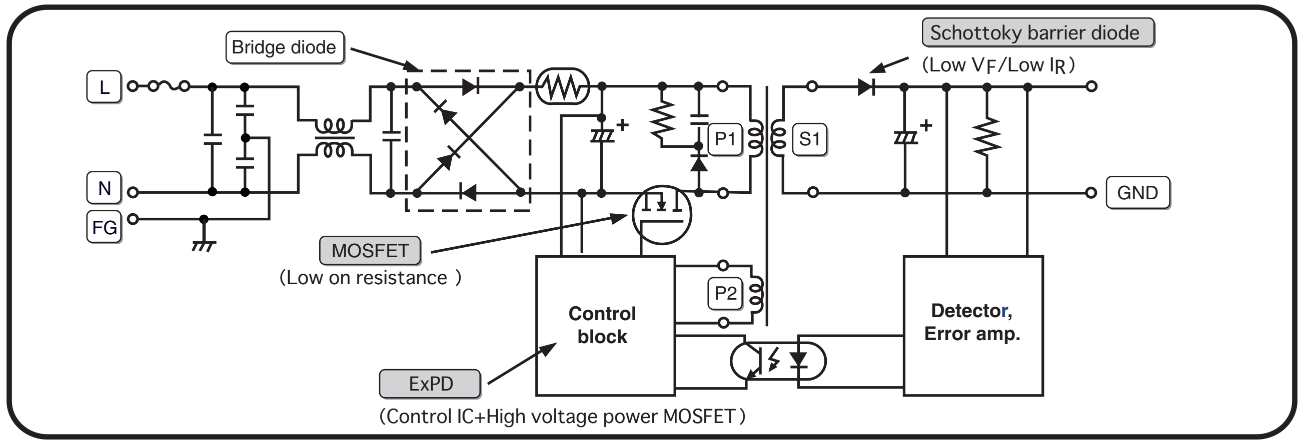
High voltage BipTR
(400V to 800V)
High voltage PowerMOSFET
(500V to 800V)

- **Reduce number of components**
  10 to 15 components
- **Sense MOSFET**
- **Delay circuit**

Discrete Devices for Switching Power Supplies and Chargers

Switching Power Supply Devices

■ Application Example



Bipolar Transistors

Type No.	Package	V_{CBO} (V)	V_{CEO} (V)	I_C (A)	P_C (Tc=25°C) (W)	h_{FE}			V_{CE}(sat)			tf max (µS)
						I_C (A)	V_{CE}=5V min	max	I_C (A)	I_B (A)	max (V)	
2SC5956	TO-220	500	400	7	40	0.8	20	50	4	0.8	0.8	0.25
2SC5959	TO-220ML				25							
2SC5957	TO-220			10	50	1.2			6	1.2		
2SC5961	TO-3PB				80							
2SC5962	TO-3PB			14	90	2.0			10	2.0		

Bridge Diode

Type No.	V_{RM}		I_O (A)	I_{FSM} (A)	V_F		I_R max (µA)
	C (V)	G (V)			I_F (A)	max (V)	
DBD10	200	600	1.0	30	0.5	1.0	10

Schottky Barrier Diodes

Type No.	Package	V_{RRM} (V)	I_O (A)	I_{FSM} (A)	V_F		I_R		Rthj-c (°C/W)	Tj max (°C)
					I_F (A)	max (V)	V_R (V)	max (µA)		
SBT80-04Y	SMP	40	8	80	3	0.55	20	100	4	150
SBT150-04Y	SMP	40	15	100	6	0.55	20	200	3	150
SBT250-04Y	SMP	40	25	120	10	0.55	20	300	1.7	150
SBT80-04J	TO-220ML	40	8	80	3	0.55	20	100	5	150
SBT150-04J	TO-220ML	40	15	100	6	0.55	20	200	4	150
SBT250-04J	TO-220ML	40	25	120	10	0.55	20	300	3.5	150
SBT350-04J	TO-220ML	40	35	140	15	0.55	20	500	3	150
SBT250-04R	TO-3PML	40	25	120	10	0.55	20	300	2.4	150
SBT350-04R	TO-3PML	40	35	200	15	0.55	20	500	2	150
SBT250-04L	TO-3PB	40	25	120	10	0.55	20	300	1.6	150
SBT350-04L	TO-3PB	40	35	200	15	0.55	20	500	1.2	150
SBT80-06J	TO-220ML	60	8	80	3	0.58	30	100	5.0	150
SBT150-06J	TO-220ML	60	15	100	6	0.58	30	200	4.0	150
SBT250-06J	TO-220ML	60	25	120	10	0.58	30	300	3.5	150
SBT350-06J	TO-220ML	60	35	140	15	0.58	30	500	3.0	150
SBT250-06L	TO-3PB	60	25	120	10	0.58	30	300	1.6	150
SBT350-06L	TO-3PB	60	35	200	15	0.58	30	500	1.2	150
SBA50-09J	TO-220ML	90	5	60	2.5	0.75	45	100	5	125
SBA100-09J	TO-220ML	90	10	80	5	0.75	45	200	4	125
SBT80-10Y	SMP	100	8	60	3	0.80	50	100	4	150
SBT150-10Y	SMP	100	15	80	6	0.80	50	200	3	150
SBT80-10J	TO-220ML	100	8	60	3	0.80	50	100	5	150
SBR100-10J	TO-220ML	100	10	80	5	0.85	50	100	4	150
SBT150-10J	TO-220ML	100	15	80	6	0.80	50	200	4	150
SBT250-10J	TO-220ML	100	25	100	9.5	0.80	50	300	3.5	150
SBT250-10R	TO-3PML	100	25	100	9.5	0.80	50	300	2.4	150
SBT350-10R	TO-3PML	100	35	160	14	0.80	50	500	2	150
SBT250-10L	TO-3PB	100	25	100	9.5	0.80	50	300	1.6	150
SBT350-10L	TO-3PB	100	35	160	14	0.80	50	500	1.2	150
SBA120-18J	TO-220ML	180	12	20	6	0.85	90	300	3	125

Switching Power Supply Devices

MOSFETs

Input Voltage AC 85 to 132V

Type No.	Package	V_{DSS} (V)	V_{GSS} (V)	I_D (A)	P_D Tc=25°C (W)	R_{DS}(on)(Ω)					Ciss typ (pF)	Use
						V_{GS}=15V typ	max	V_{GS}=10V typ	max	I_D (A)		
2SK2406*	TP	450	±30	1	30	-	-	3.5	4.5	0.5	300	AC Adapter
2SK1690	SMP	450	±30	3	50	-	-	2.0	2.6	1.5	400	
2SK1691	SMP	450	±30	5	40	-	-	1.0	1.4	2.5	700	
2SK1443LS	TO-220FI(LS)	450	±30	1	20	-	-	3.5	4.5	0.5	250	
2SK1444LS	TO-220FI(LS)	450	±30	3	25	-	-	2.0	2.6	1.5	400	
2SK1445LS	TO-220FI(LS)	450	±30	5	30	-	-	1.0	1.4	2.5	700	
2SK1446LS	TO-220FI(LS)	450	±30	7	35	-	-	0.6	0.8	4.0	1200	
2SK1447LS	TO-220FI(LS)	450	±30	9	40	-	-	0.47	0.6	6.0	1600	
2SK2787LS*	TO-220FI(LS)	450	±30	8	40	-	-	0.55	0.75	5.0	1500	
2SK1451	TO-3PML	450	±30	8	50	-	-	0.6	0.8	4.0	1200	
2SK1452	TO-3PML	450	±30	10	60	-	-	0.47	0.6	6.0	1600	FAX, Monitor
2SK1453	TO-3PML	450	±30	16	70	-	-	0.24	0.3	8.0	3200	
2SK1448	TO-3PB	450	±30	8	100	-	-	0.6	0.8	4.0	1200	
2SK1449	TO-3PB	450	±30	12	120	-	-	0.47	0.6	6.0	1600	
2SK1450	TO-3PB	450	±30	20	150	-	-	0.24	0.3	10.0	3200	
2SK1454	TO-3PBL	450	±30	30	250	-	-	0.12	0.16	15.0	6400	
2SK2616	TP	500	±30	2	30	3.0	4.0	-	-	1.0	300	
2SK2617LS	TO-220FI(LS)	500	±30	4	25	1.2	1.6	-	-	2.0	550	
2SK2618LS	TO-220FI(LS)	500	±30	5	30	0.95	1.25	-	-	3.0	700	

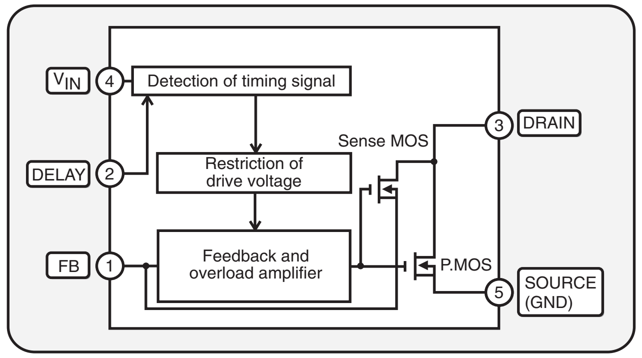
Input Voltage AC 170 to 264V

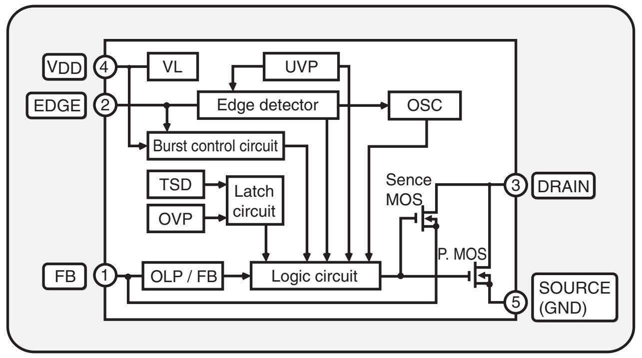
Type No.	Package	V_{DSS} (V)	V_{GSS} (V)	I_D (A)	P_D Tc=25°C (W)	R_{DS}(on)(Ω)					Ciss typ (pF)	Use
						V_{GS}=15V typ	max	V_{GS}=10V typ	max	I_D (A)		
2SK2623	TP	600	±30	1.5	30	4.2	5.5	-	-	0.8	300	AC Adapter
2SK3491	TP	600	±30	1	20	-	-	8.5	11	0.5	135	
2SK2919*	ZP	600	±30	2	35	-	-	3.2	4.3	1.0	400	
2SK1459LS	TO-220FI(LS)	600	±30	2.5	30	-	-	4.7	6.0	1.5	350	
2SK2043LS*	TO-220FI(LS)	600	±30	2	25	-	-	3.2	4.3	1.0	400	
2SK2624LS	TO-220FI(LS)	600	±30	3	25	2.0	2.6	-	-	2.0	550	
2SK2625LS	TO-220FI(LS)	600	±30	4	30	1.5	2.0	1.2	1.6	2.5	700	
2SK2628LS	TO-220FI(LS)	600	±30	6	35	0.9	1.1	-	-	2.0	1050	
2SK2632LS	TO-220FI(LS)	600	±30	2.5	25	3.6	4.8	-	-	1.3	550	
2SK2631	TP	800	±30	1	30	7.5	10	-	-	0.5	300	
2SK2678LS	TO-220FI(LS)	800	±30	1.5	20	4.2	5.5	-	-	0.8	300	
2SK3852	TP	900	±30	0.4	30	-	-	50	70	0.15	70	FAX, Monitor
2SK1458LS	TO-220FI(LS)	900	±30	0.2	20	-	-	50	70	0.1	45	
2SK1464	TO-3PML	900	±30	8	80	-	-	1.2	1.6	4.0	1600	
2SK1466	TO-3PBL	900	±30	16	250	-	-	0.6	0.8	8.0	3200	
2SK2347	TO-3JML	1000	±20	20	160	-	-	0.6	0.8	10.0	3300	
2SK3747	TO-3PML	1500	±20	2	50	-	-	10	13	1.0	400	

* : FRD built in

Discrete Devices for Switching Power Supplies and Chargers

Quasi-resonant type Block Diagram





Pin No.	Symbol	Function
1	FB	Input for feedback voltage and current sense
2	DELAY	Input for timing signal
3	DRAIN	Power MOSFET Drain
4	V_{IN}	Start-up voltage and drive voltage
5	SOURCE(GND)	Power MOSFET Source (ground)

Pin No.	Symbol	Name	Function
1	FB	Over current feedback pin	Input for feedback voltage and current sence
2	EDGE	EDGE detection pin	Input for timing signal
3	DRAIN	Drain pin	Power MOSFET drain
4	V_{DD}	Power pin	Input for start-up voltage and drive voltage
5	SOURCE(GND)	Source (ground) pin	Power MOSFET Source (ground)

Delay -RCCt type ExPD

Type No.	V_{DSS} (V)	I_D (A)	R_{DS}(on) (Ω)		Input Voltage (VAC)	Max* Power (W)
			typ	max		
TN4R01	450	4.5	1.25	1.6	100/120	90
TN4R02		6	0.95	1.3		120
TN4R03		3	1.95	2.5		60
TN4R04		6.5	0.8	1.04		130
TN6R03	650	4.5	1.55	2	220	160
					WIDE	80
TN6R04		5.5	1.2	1.6	220	180
					WIDE	90
TN6R05		6.5	0.95	1.2	220	200
					WIDE	100
TN8R01	800	2.5	3.9	5.2	220	
					WIDE	50
TN8R02		3	3.1	3.9	220	120
					WIDE	60
TN8R03		4.5	1.75	2.3	220	160
					WIDE	80
TN8R04		3.5	2.45	3.2	220	140
					WIDE	70

Quasi-resonant type ExPD

Type No.	V_{DSS} (V)	I_D (A)	R_{DS}(on) (Ω)		Input Voltage (VAC)	Max* Power (W)
			typ	max		
TN6Q03	650	4.5	1.6	2.1	220	160
					WIDE	80
TN6Q04		5.5	1.2	1.6	220	180
					WIDE	90

* : The avove-mentioned output electric power changes also with heat dissipation conditions and minimum input voltage ranges. Therefore, please consider these numerical values as a value of a standard.

Chargers

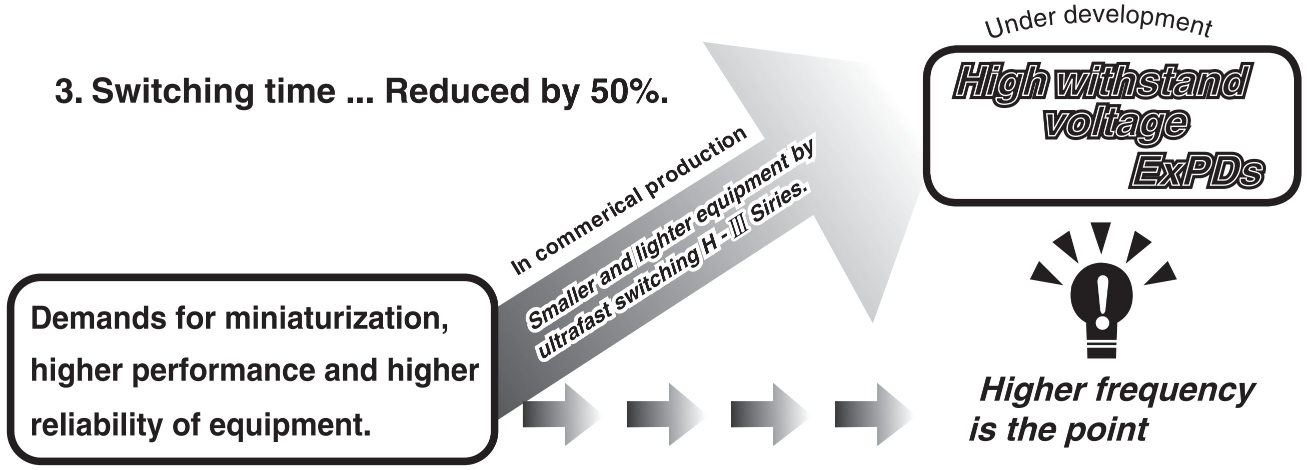
■ **H-Ⅲ Series best suited for switching power supplies of battery chargers and AC adapters in various kinds of portable equipment.**

Features

1. **Achieves ultrafast switching operation by adopting SANO innovative LGCP* technology.**
   (*: Low Gate -Charge Proces). **In commerical production**

2. **Low Qg (gate charge) ... Reduced by 40%.**

3. **Switching time ... Reduced by 50%.**



Lineup

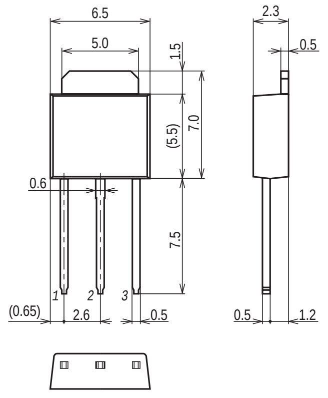
Type No.	Package	V_{DSS} (V)	V_{GSS} (V)	I_D (A)	R_{DS}(on)(Ω)				Ciss typ (pF)	Qg typ (nC)
					V_{GS}=15V		V_{GS}=10V			
					typ	max	typ	max		
2SK2406*	TP	450	±30	1.0	-	-	3.5	4.5	300	-
2SK1443LS	TO-220FI(LS)	450	±30	1.0	-	-	3.5	4.5	250	-
2SK1444LS	TO-220FI(LS)	450	±30	3.0	-	-	2.0	2.6	400	-
2SK1445LS	TO-220FI(LS)	450	±30	5.0	-	-	1.0	1.4	700	-
2SK1446LS	TO-220FI(LS)	450	±30	7.0	-	-	0.6	0.8	1200	-
2SK2787LS*	TO-220FI(LS)	450	±30	8.0	-	-	0.55	0.75	1500	-
2SK2616	TP	500	±30	2.0	3.0	4.0	-	-	300	8
2SK2617LS	TO-220FI(LS)	500	±30	4.0	1.2	1.6	-	-	500	15
2SK2618LS	TO-220FI(LS)	600	±30	5.0	0.95	1.25	-	-	700	20
2SK2623	TP	600	±30	1.5	4.2	5.5	-	-	300	8
2SK3491	TP	600	±30	1.0	-	-	8.5	11	135	6
2SK3850	TP	600	±30	0.7	-	-	14	18.5	96	4
2SK2678LS	TO-220FI(LS)	600	±30	1.5	4.2	5.5	-	-	300	8
2SK2624LS	TO-220FI(LS)	600	±30	3.0	2.0	2.6	-	-	550	15
2SK2625LS	TO-220FI(LS)	600	±30	4.0	1.5	2.0	-	-	700	20
2SK2628LS	TO-220FI(LS)	600	±30	6.0	0.9	1.1	-	-	1050	30
2SK2631	TP	800	±30	1.0	7.5	10	-	-	300	8
2SK2632LS	TO-220FI(LS	800	±30	2.5	3.6	4.8	-	-	550	15
2SK3852	TP	900	±30	0.4	-	-	50	70	70	-
2SK1458LS	TO-220FI(LS)	900	±30	0.2	-	-	50	70	45	-
2SK1459LS	TO-220FI(LS)	900	±30	30	-	-	4.7	6.0	350	-

* : FRD built in.

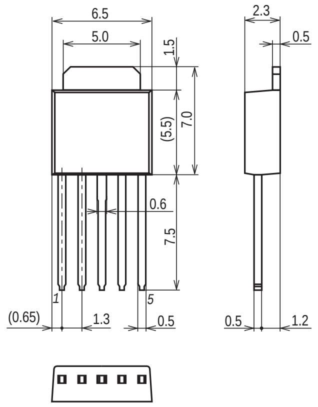
Package Dimensions

(Reference Drawing) (unit:mm)

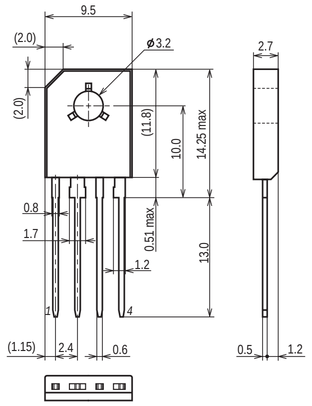
TP3H



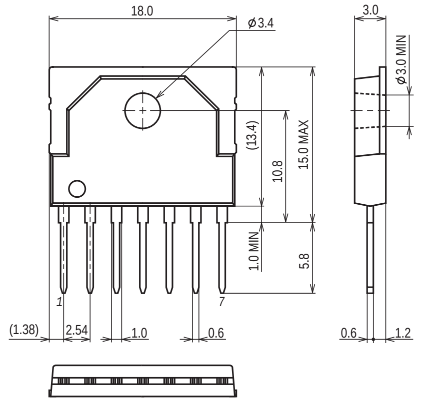
TP5H



SIP4H



SIP7H



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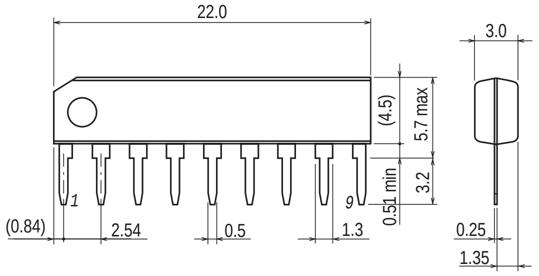
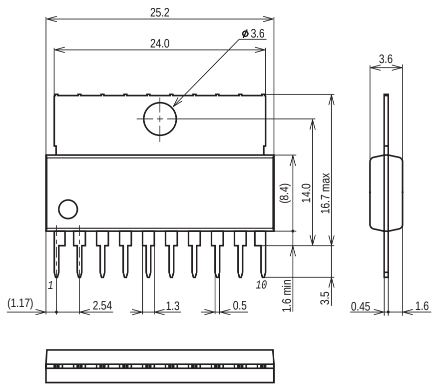


SIP10F



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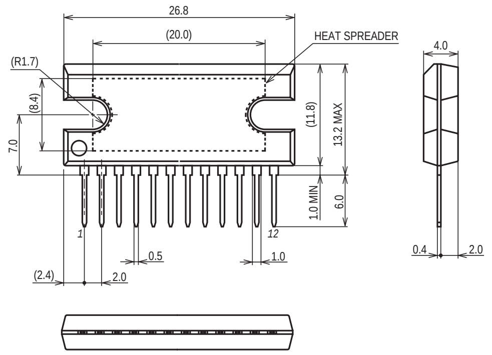

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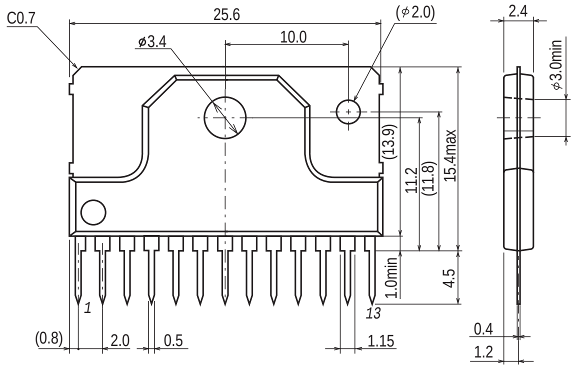

(Reference Drawing) (unit:mm)

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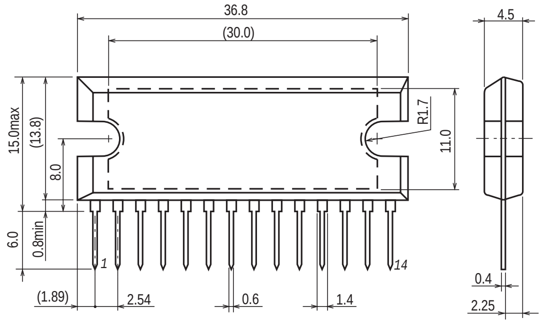

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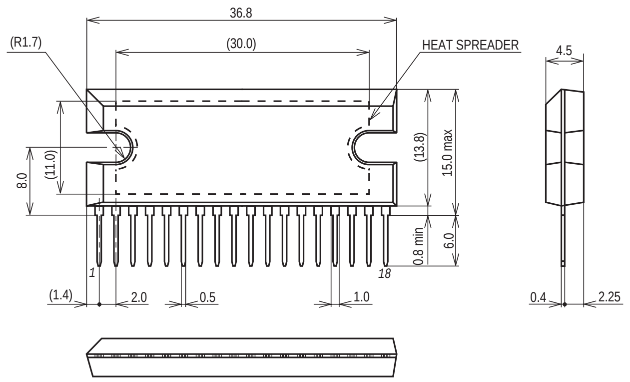
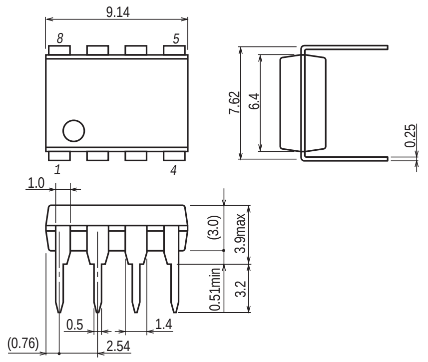


DIP8 (300mil)



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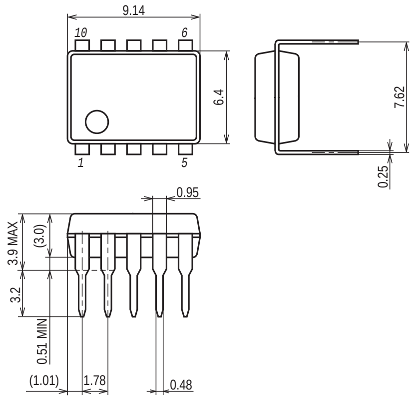
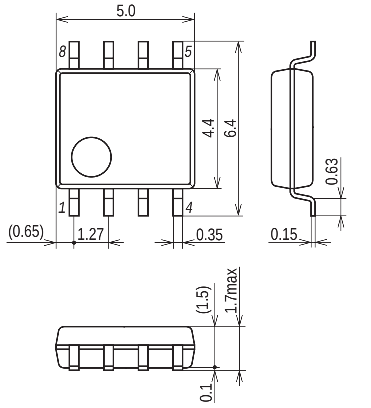


MFP8 (225mil)



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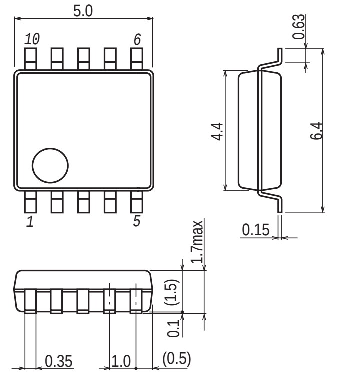

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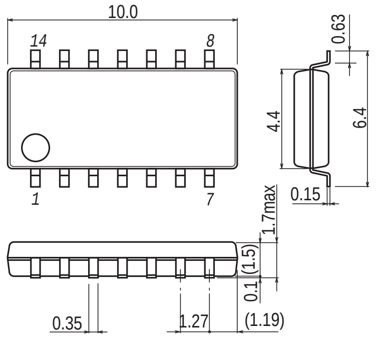

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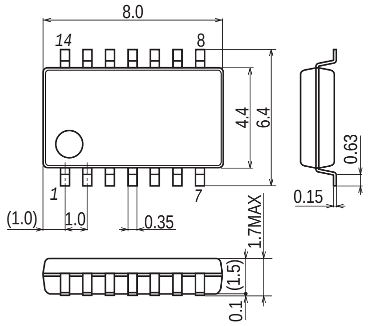

(Reference Drawing) (unit:mm)

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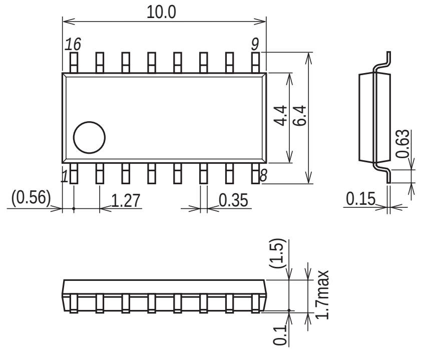
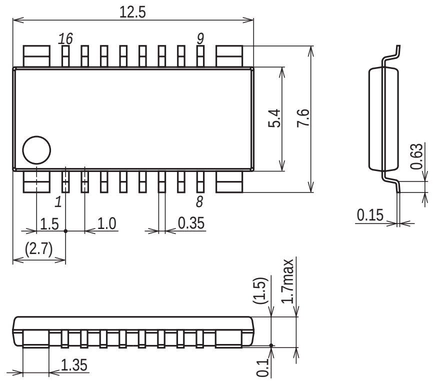


MFP16FS (300mil)



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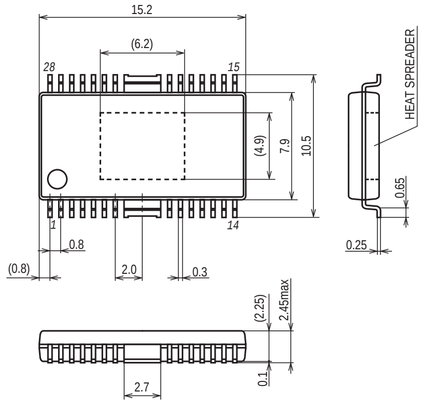
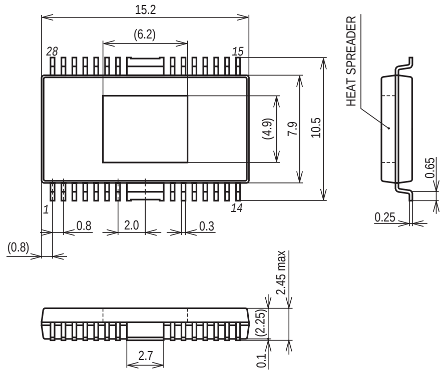
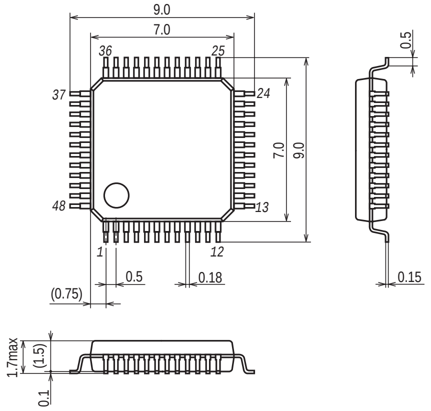


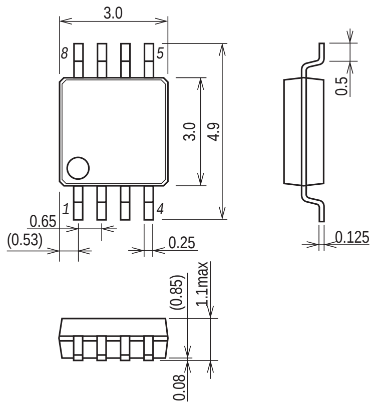
HSOP28HC (375mil)



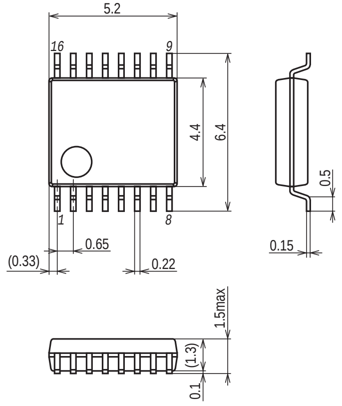
SQFP48 (7 × 7)



MSOP8 (150mil)



SSOP16 (225mil)



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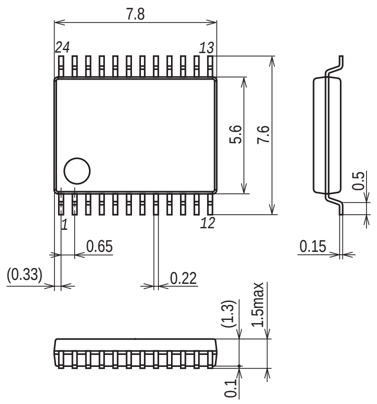

(Reference Drawing)

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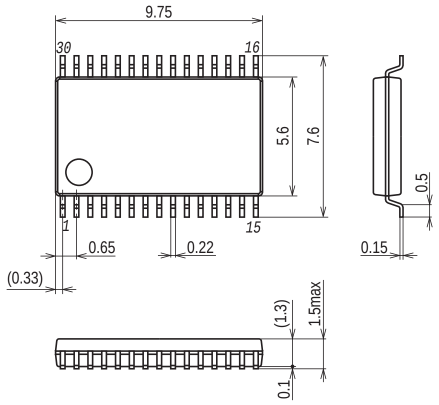
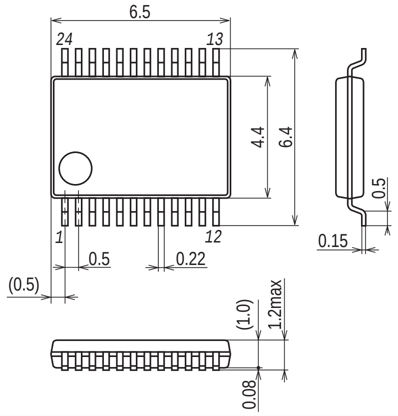


TSSOP24 (225mil)



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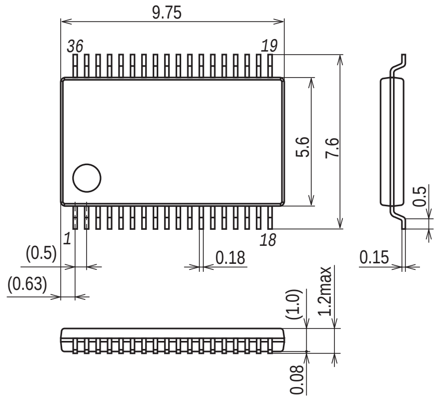
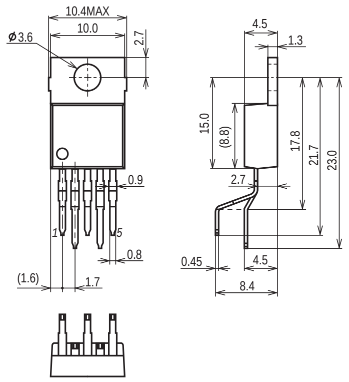


TO220-5H



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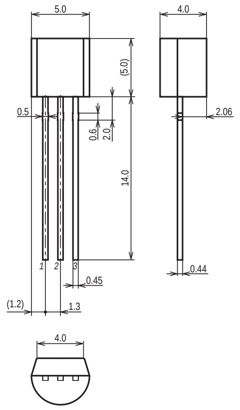
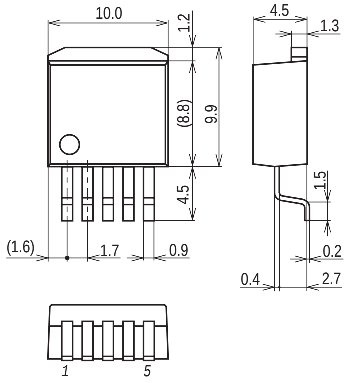
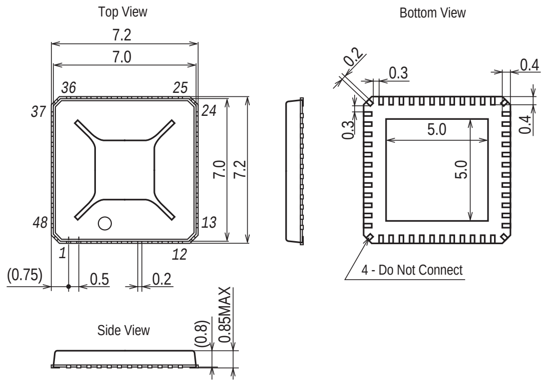


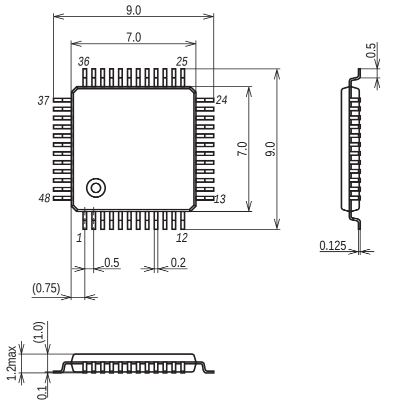
SMP5



VQFN48(7 × 7)

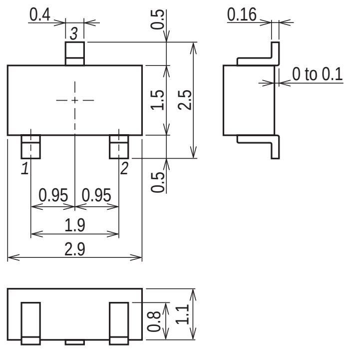


TQFP48J (7 × 7)



Package Dimensions

CP



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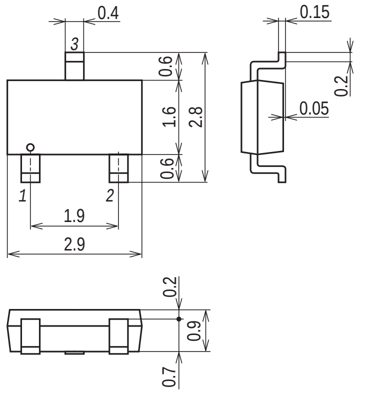

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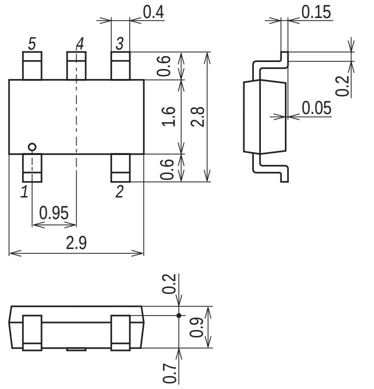

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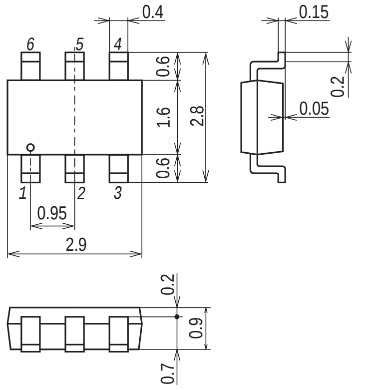

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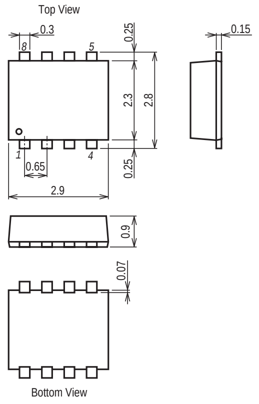
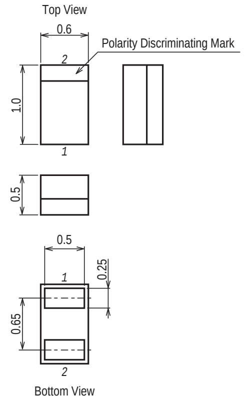


ECSP1006-2



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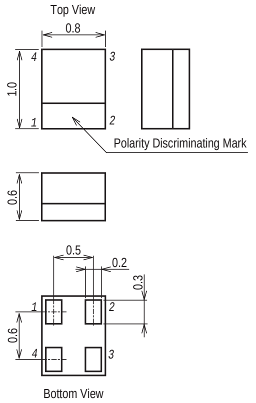

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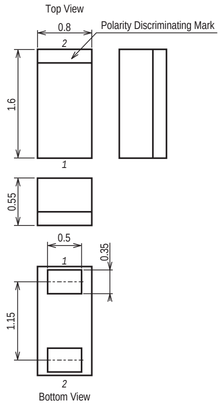

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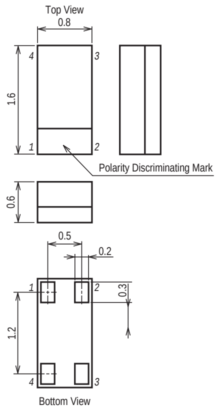
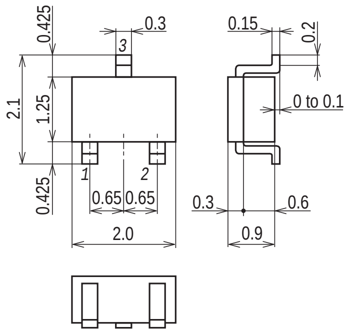


MCP



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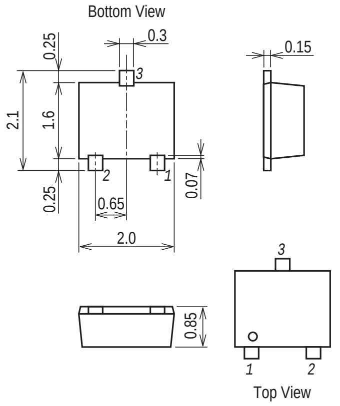
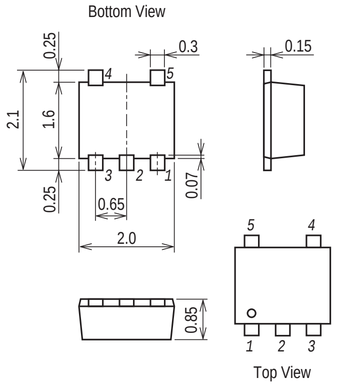


MCPH5



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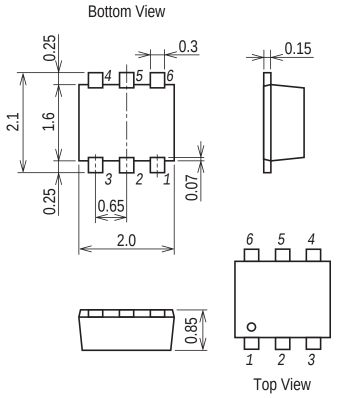
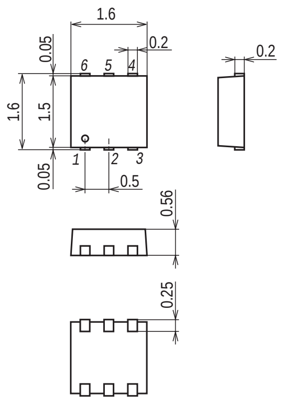
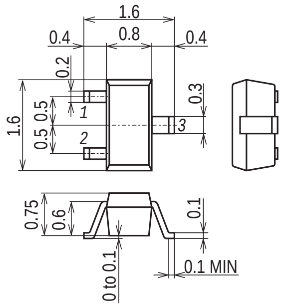


SCH6



SMCP



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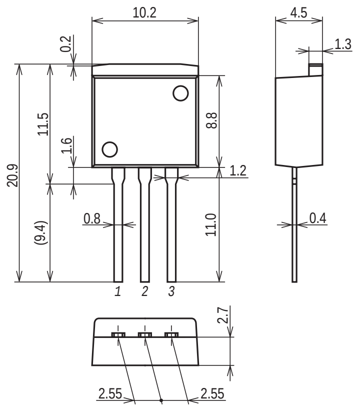
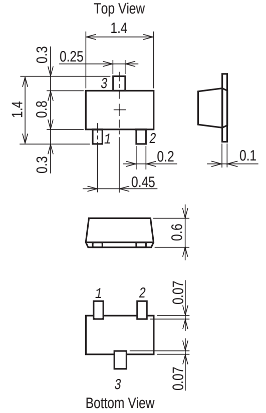
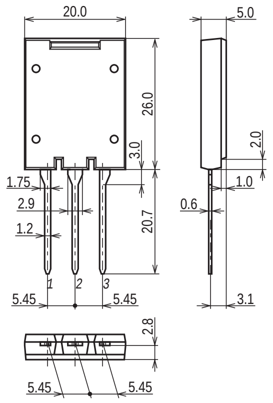


Package Dimensions

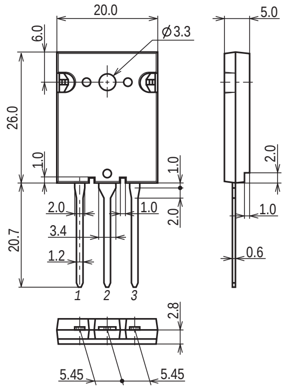
SSFP



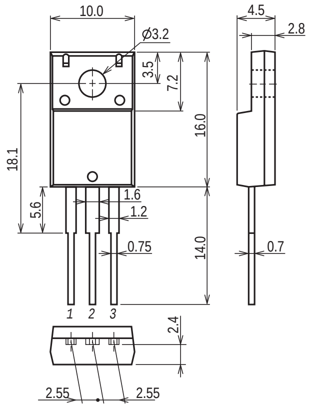
TO-3JML



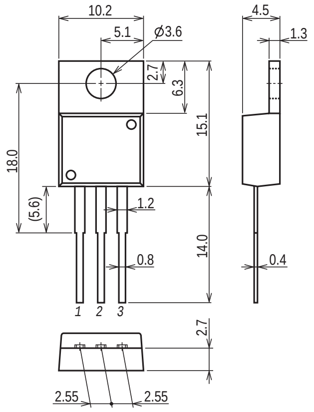
TO-3PBL



TO-220ML



TO-220



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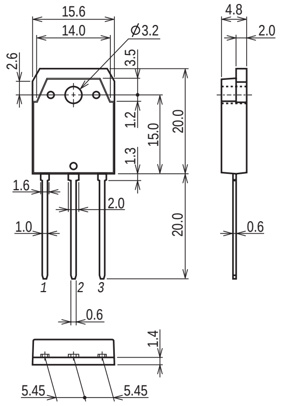

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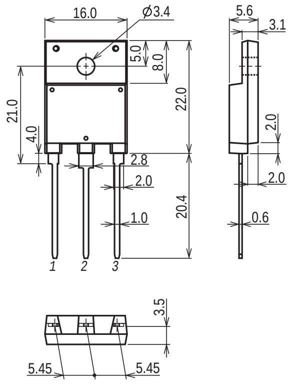

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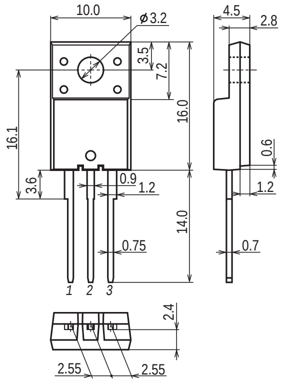

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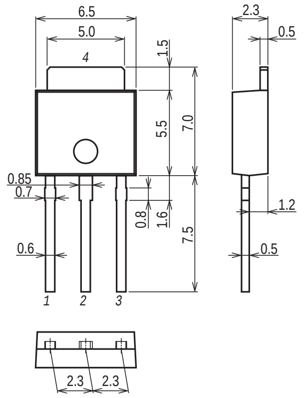

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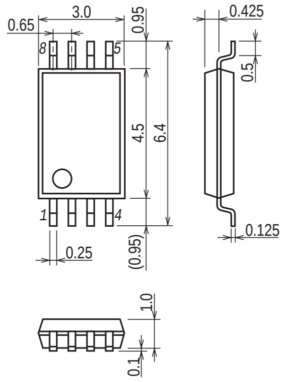
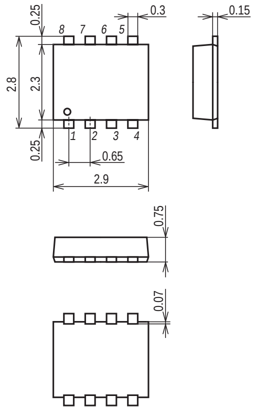
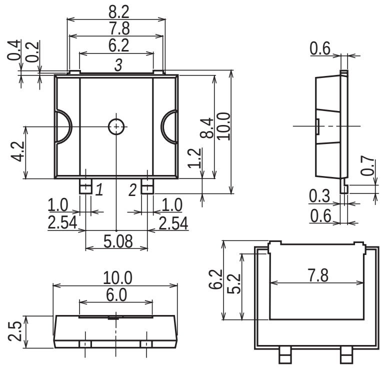


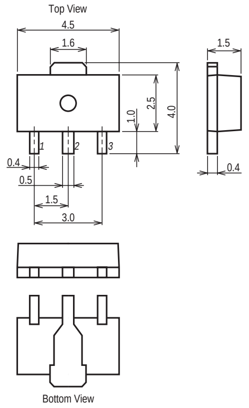
VEC8



ZP



PCP type A



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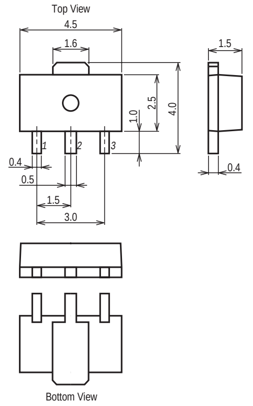

Notes on Package Types, Naming and Dimensions
The package names used in this documentation are designed to indicate a rough classification of the packages used, and do not necessarily indicate the formal name of each individual package. Additionally, these package dimensions are reference values. Refer to the delivery specifications document of a particular product for the dimensions and formal name of the package.