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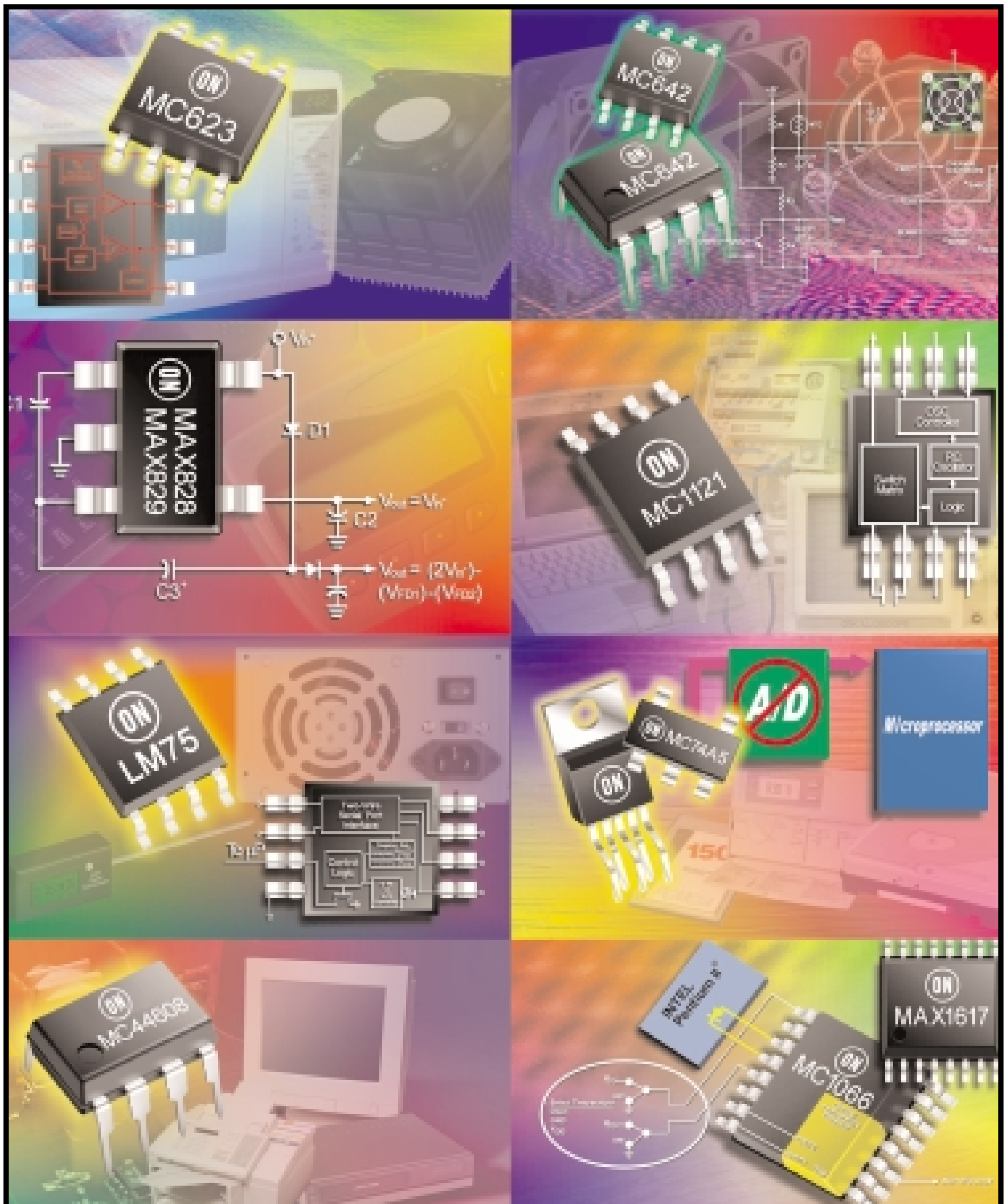
ON-Display™

This Quarter...



ON Semiconductor Shows Commitment in the Analog Integrated Circuits Field with Multiple Product Introductions and the Acquisition of Cherry Semiconductor

For additional information, please contact your ON Semiconductor Sales Representative. Comments, corrections and editorials are welcomed. Please contact Gary Malmberg in the Marketing Communications Group at (+1) 602.244.4984 or by email at gary.malmberg@onsemi.com.

To order literature on any of these products, see the Literature Distribution Center Information on page 27.

From the Editor . . .

It's no surprise that electronic products of the 21st century are comprised of an increasing amount of semiconductor content. Virtually everything we touch contains some form of silicon. Although embedded computing semiconductors receive most of the attention, the complete system's functionality depends on a variety of semiconductor technologies.

ON-Display™ is a technology and applications resource for engineers who need to get their designs off the bench into production, more efficiently and cost effectively. Each edition promises detailed and timely information that spans a variety of markets including data and power management for wireless, networking, telecommunication, and transportation.

ON Semiconductor – the publisher of ON-Display – is an industry leader that is fast and focused. Although we trace our roots back more than 40 years in the semiconductor business, we're focused on the future; providing one of the largest semiconductor portfolios in the industry. ON Semiconductor shipped over 19 billion units in 1999 and holds approximately 17,000 product offerings, of which 10,000 are dedicated to data and power management. You'll find our semiconductor products in virtually every data and power management product and system.

We want to work with you as a smart, reliable, nimble partner. To do that we place a high priority on your feedback, comments and ideas. The goal of ON-Display, is to provide you with real-time, ready-to-deliver technology and applications. The best way to know if we are accomplishing our goal is by receiving your input. Please take a moment to complete the enclosed card with your comments or drop me a line at gary.malmberg@onsemi.com.

I hope you enjoy this premiere issue of ON-Display.

Gary Malmberg, Editor-in-Chief

FEATURE

ON Semiconductor Adds Cherry Semiconductor Products to Analog Portfolio

On April 4, 2000 - ON Semiconductor announced that it successfully completed the acquisition of the Cherry Corporation's semiconductor subsidiary for $250 million. The purchase includes all of the worldwide business and assets of Cherry Semiconductor.

"We welcome the employees of Cherry Semiconductor to the ON Semiconductor team," states Steve Hanson, Chief Executive Officer and President of ON Semiconductor. "Together we can provide an even higher level of support to wireless, automotive and computer customers with our combined engineering expertise and power management product portfolio."

Cherry Semiconductor's portfolio consists of analog integrated circuit (IC) solutions for the power management and automotive markets. Cherry Semiconductor's expertise in analog design provides ON Semiconductor with additional analog design, product development and manufacturing capabilities worldwide. The Cherry Semiconductor plant in Greenwich, Rhode Island will operate as an essential part of the growth strategy in power management of ON Semiconductor's analog business. In addition, Cherry's strength in the automotive, communication and industrial markets enhances ON Semiconductor's commitment to building strategic market relationships.

The strength of these two companies, focused on quality analog, logic and discrete semiconductors, combine to form a powerful new industry leader in analog; a nimble company that anticipates and embraces the future; committed to service and always on the move.

CONTENTS

PRODUCT SPECIFIC Articles

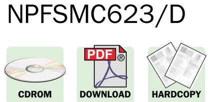
GENERAL Articles

MC623 Features

- Integrated Temperature Sensor and Detector Operate from a Supply
- Supply Voltage as Low as 2.7V
- Replaces Mechanical Thermostats and Switches
- On–Chip Temperature Sensor
- 2 User–Programmable Temperature Set Points
- 2 Independent Temperature Limit Outputs
- Operating Temperature Range: –40°C to +85°C
- 8–Pin SOIC for Direct PCB Mounting
- Heat/Cool Regulated Output

Available Literature

MC623/D
NPFSMC623/D



Pricing to Start at:

MC623DR2
$1.46 for 1000 Pcs

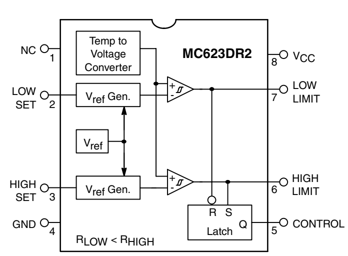
ANALOG INTEGRATED CIRCUITS

3-Volt Dual Trip Point Temperature Sensor - MC623DR2

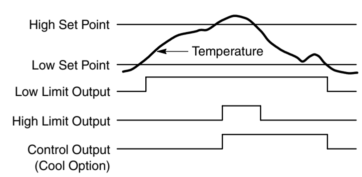
Thermal management has never been easier. ON Semiconductor's growing Thermal Management IC family now includes the MC623DR2, specifically suited to the ever-changing computer, consumer and industrial markets.

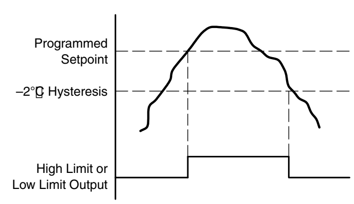
The MC623DR2 from ON Semiconductor is a 3-volt dual trip point programmable temperature sensor for a variety of thermal management applications. It will operate from a supply voltage as low as 2.7 volts or as high as 4.5 volts, and includes an on-chip sensor to read ambient temperature. Low- and high-limit thresholds are individually set with a single external resistor, and separate output interrupt flags are provided for exceeding each limit. In addition, a separate output pin is provided as a simple on/off control for a cooling fan, if desired. The MC623DR2 is packaged in the cost-effective, popular surface mount SOIC-8.

Typical applications for the MC623DR2 include CPU thermal management, and it is commonly used to provide accurate temperature sensing for appliances and environmental controls. Its output can be used to trigger external pulse width modulated fan speed control circuits, and the two user-programmable temperature set points provide a convenient shutdown control by providing two independent temperature limit output flags. The high accuracy and reliability of the MC623DR2 makes it a clear candidate for the replacement of mechanical thermostats and switches.



The MC623DR2 consists of a positive temperature coefficient sensor, which produces a ±30°C absolute temperature sensing accuracy, a dual threshold detector and support circuitry. User programming of the set points is easily accomplished using external resistors from the HIGH SET and LOW SET inputs to V_{CC}.





Below the LOW LIMIT set point, the outputs remain inactive. Within the HIGH/LOW set point range, the LOW LIMIT is driven high. Above the HIGH LIMIT, the CONTROL output is driven high, providing logic for simple ON/OFF fan control.

To prevent undesirable output "chattering", the LOW and HIGH SET inputs each have a built-in hysteresis of –20°C maximum. Each of the LIMIT outputs remains active until the measured temperature falls a maximum of 20°C below the programmed thresholds. Outputs are driven active when the temperature lies within 30°C of the set point values, and remain active until the temperature falls an additional 20°C below the set point, because of the hysteresis.

User controlled HIGH and LOW limits easily programmed with two external resistors, keeping size and cost to a minimum.

Because of its small size, the MC623DR2 can be mounted under (or near) the system CPU chip. This short path to the heat source provides early warning of impending thermal overloads, and makes it unnecessary to use external thermistors in many configurations. Also, the straightforward function of the MC623DR2 allows it to support all common CPU power supplies.

When compared to discrete circuits and other competing sensing devices, MC623DR2 is a clear choice due to its accurate operation, ease of use, low installed cost, reliability and small size.

A detailed data sheet containing full specifications and pin assignments is available for the MC623DR2.

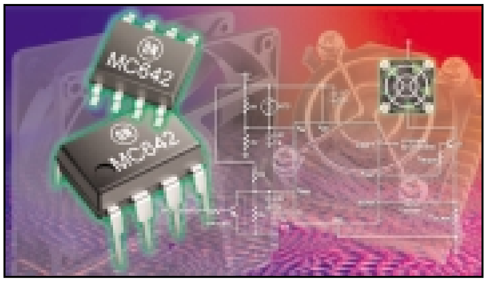
For more information see the ON Semiconductor website: **www.onsemi.com** and search documentation for MC623/D.

by Larry Hayes
Product Launch Manager

To order literature on any of these products, see the Literature Distribution Center Information on page 27.

ANALOG INTEGRATED CIRCUITS

PWM Fan Speed Controller with Fault Detection - MC642



The MC642 is yet another addition to the ON Semiconductor Thermal Management IC family. It is specifically suited to the fast growing computer, consumer and industrial markets.

The MC642 is a pulse-width modulated (PWM) fan speed control IC with integrated fault detection circuitry. It converts any standard two-wire brushless DC fan into an intelligent fan by providing temperature proportional speed control.

With an operating temperature range of 0ºC to +85ºC, the MC642 is capable of serving a wide variety of applications including power supplies, personal computers, file servers, telecom equipment, uninterruptible power supplies, power amplifiers, and as a general purpose fan speed

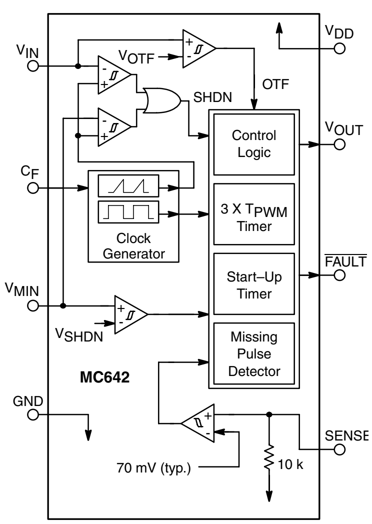


Figure 1. MC642 Block Diagram

controller. It is frequently used with DC motors, providing proportional speed control.

The benefits of proportional speed control make the MC642 a popular device. By avoiding full speed operation when unnecessary, average current is reduced and power is conserved, making the MC642 ideal for "green systems". In addition, a shutdown feature is included. Annoying acoustic noise is also minimized by allowing the fan to operate at reduced speeds whenever possible. PWM frequency is adjustable, and many users have chosen to set the frequency at around 30 kHz to further minimize acoustic noise.

The MC642 monitors and controls brushless DC motors of any current or voltage. A thermistor connected to the V_{IN} pin furnishes the required control voltage of 1.25 to 2.65 volts for 0% to 100% PWM duty cycle. The MC642 supports the use of low cost, negative temperature coefficient (NTC) and positive temperature coefficient (PTC) thermistors. In the NTC thermistor, the thermistor's resistance decreases as temperature rises; just the opposite is true for the PTC.

Minimum fan speed is set with a resistor divider on the V_{MIN} input. This feature is beneficial to users who wish to maintain a positive air flow at all times to minimize dust penetration. Also, maintaining some movement of the fan avoids concerns that the fan is not operational, which may be desirable in personal computers and some consumer devices.

The PWM circuit consists of a

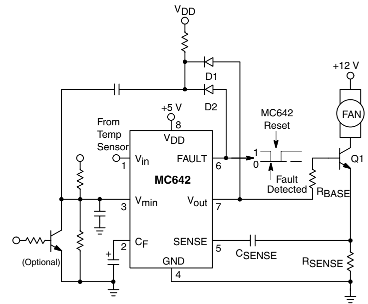


Figure 2. Typical Fan Speed Control Circuit Diagram

ramp generator and threshold detector. Because the V_{OUT} output provides asymmetric complementary drive, it is capable of driving low cost NPN bipolar transistors or N-channel MOSFETs. The SENSE input, pin 5, is connected to a low value current sensing resistor in the ground leg of the fan circuit. During normal fan operation, commutation occurs as each pole of the fan is energized. This commutation causes brief interruptions in the fan current, evidenced as pulses across the sense resistor. A fault condition is determined when the device is not in shutdown mode and pulses do not appear at the SENSE input.

An integrated start-up timer ensures reliable motor startup at turn-on, coming out of shutdown mode, or following a transient fault by turning on V_{OUT} for 32 cycles of the PWM.

A FAULT is detected due to one of several conditions. When pulses appearing at the SENSE input are blanked, the remaining pulses are filtered by a missing pulse detector. Consecutive pulses not detected for 32 PWM cycles trigger the start-up timer. A second fault latches the device. Also, when the PWM control voltage (V_{IN}) is greater than needed to drive a 100% duty

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MC642 Features

- Shutdown Mode for Power Saving
- Supports Low Cost NTC/PTC Thermistors
- Ideal for "Green Systems"
- Temperature Proportional Speed for Acoustic Control /Longer Fan Life
- Fan Voltage Independent of MC642 Supply Voltage
- Fault Detection Circuits Protect Against Fan Failure and Aid System Testing
- Operating Temperature Range: 0°C to +85°C

Available Literature

MC642/D
NPFSMC642/D

CDROM DOWNLOAD HARDCOPY

Pricing to Start at:

MC642DR2
$1.37 for 1000 Pcs

ANALOG INTEGRATED CIRCUITS

MC642
continued

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cycle, a system warning occurs, but the fan keeps running. A stalled, open or disconnected fan causes a restart one time, but if the fault persists, the FAULT flag is set and the device is latched in shutdown mode. Note that the PWM frequency is the time base for the startup and fault timers.

When used with a microcontroller, routine fan control functions can be performed by the MC642 without process intervention from the microcontroller. The MC642 calculates a fan operating speed based on an algorithm specific to the application. The processor controls fan speed using complementary port bits I/0 1 through I/0 3. R1 through R6 form a simple 3-bit DAC that translates the processor's outputs into a 1.6 volt DC control signal.

Setting V_{MIN} to 1.8 volts, the minimum operating speed is approximately 40% of full rated speed when the processor's output code is 000. An open drain output from the processor can reset the MC642 following detection of a fault condition. The FAULT output can be connected to the processor's interrupt input, or to an I/O pin for polled operation.

The device is available as MC642P, a through-hole 8-pin DIP, or as MC642DR2, a surface mount SOIC-8.

A datasheet containing full specifications, pin assignments and packaging options is available. The datasheet may be ordered using by the number MC642/D, and is available at the ON Semiconductor web site: **www.onsemi.com**

by Larry Hayes
Product Launch Manager

Additional information on the MC642, such as pricing, key features and available literature, is located on page 5.

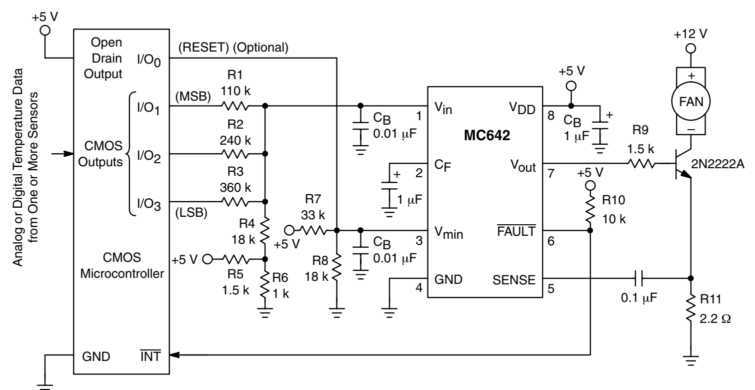


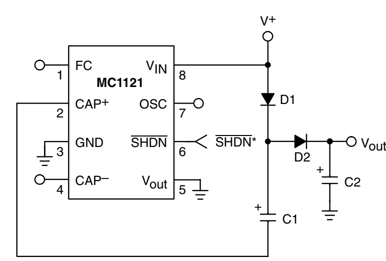
Figure 3. The MC642 as a Microcontroller Peripheral

Power Management Devices from ON Semiconductor

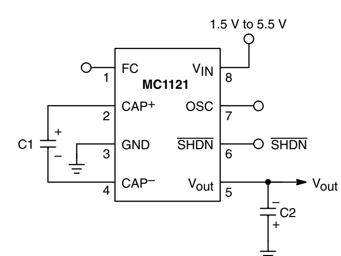
MC1121 Charge Pump

Charge Pump Voltage Converter/Doubler: MC1121DMR2

- 100 mA of output current capability and a power saving shutdown mode
- Excellent efficiency and low switching noise while generating up to 100 mA of output current
- Alternative to the MAX766x, the MAX660 and other unregulated charge pumps
- Uses no inductors, reducing EMI and permitting significant board and cost savings
- Acts as an inverter by converting a 2.4 V to 5.5 V input to a corresponding negative output voltage
- Acts as a voltage doubler by doubling the applied input voltage
- Available in Micro8™ package



Positive Voltage Doubler



NOTES: *SHDN should be tied to V_{IN} if not used.

Voltage Inverter

Available Literature
MC1121/D
NPFSMC1121/D

CDROM DOWNLOAD HARDCOPY

Pricing to Start at:
MC1121DMR2
$1.24 for 5000 Pcs

To order literature on any of these products, see the Literature Distribution Center Information on page 27.

ANALOG INTEGRATED CIRCUITS

Power Management Devices from ON Semiconductor

Charge Pump Voltage Converters: MAX828SNTR and MAX829SNTR

- Invert and/or double an input voltage that ranges from +1.5 V to +5.5 V
- Are ideal for portable products such as cellular phones, pagers, PDAs, data loggers and other battery powered products
- Require only two external capacitors for standard voltage inverter applications
- Conversion efficiency typically greater than 95%
- Quiescent current value as low as 50 μA for the MAX828
- Up to 25 mA output current for the MAX829
- Available in ultra-small SOT-23-5 lead package
- Pin-to-pin replacements for the industry standard MAX828 and MAX829

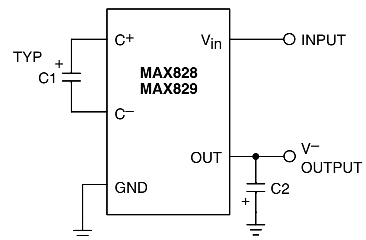


Figure 1. Typical Application

MAX828 MAX829 Charge Pumps

Available Literature

MAX828/D
NPFSMAX828/D

CDROM DOWNLOAD HARDCOPY

Pricing to Start at:

MAX82*x*SNTR
$0.65 for 12,000 Pcs

APPLICATIONS

GreenLine™ Power Supply from ON Semiconductor

GreenLine, Blue Angel, Energy Star – Today's key word in the appliance industry is Energy Savings.

The worldwide technical community recognizes that the energy consumption due to standby losses in houses and offices is a major contributor to environmental pollution. When systems like TV receivers, monitors, printers and VCRs are in the standby mode, the question is, "How much power are they consuming"? The energy consumption of appliances is in two distinct modes: The "active mode" and the "waiting," or standby mode. While in the active mode, energy savings can be achieved by lowering the power demand while maintaining identical system performance. Power supply efficiency directly affects the savings in the global system energy. In the standby mode the approach is somewhat different: Generally, a "wake-block" of components is permanently powered in order to be ready to re-activate the whole system.

This article explains how the Greenline power supply improves system efficiency and energy savings.

1-Watt in Standby

The tendency is to aim at a 1 W consumption for any apparatus supplied by a wall outlet when in the standby mode, and several power management options are available to achieve this goal. The classical technique, consisting of disabling the secondary loads while keeping the power supply running, is no longer preferred. In fact, even in a disabled mode, the loads are generally presenting some 100 mW of leakage in the case of monitors or TV receivers. A solution to cancel this leakage is to totally disconnect the loads. Another technique consists of completely disabling the main power supply during the standby mode and installing a micropower side-power supply to operate the wake-up block.

The ON Semiconductor controller, the MC44608, is designed to address the difficulties encountered in these two known techniques, to allow a high efficiency switched-mode power supply (SMPS) to be built. Thanks to an efficient "SMPS status detection" technique, a "secondary reconfiguration" can be used to perform leakage suppression. This loss suppression is achieved by a sharp reduction of the secondary supply rail voltages, with the exception of the low-voltage rail that feeds the wake-up block.

SMPS Secondary Reconfiguration

The SMPS transformer exists to partition the primary/secondary energy transfer, of course, with the ratio between the primary winding and each of the secondary windings determining the output voltages.

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MC44608 Low Standby Power PWM Controller Meets GreenLine Specifications

Available Literature

MC44608/D
PBMC44608/D
MTP6N60E/D
TL431/D
MCR22-6/D
SMPSRM/D

CDROM DOWNLOAD HARDCOPY

APPLICATIONS

GreenLine™ Power Supply
continued

For additional information on the MC44608, including pricing, see page 10.

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The regulation is on the outputs, which must present the best stability during the normal mode of operation.

The principle of the secondary reconfiguration lies in the modification of the winding turns ratio for the desired regulated output, activated by the switch located on the secondary side of the SMPS. The switch arrangement (see Fig. 1) establishes the connection between a high-voltage winding (high turns ratio) and the supply rail for the wake-up block. In standby the switch is closed. In this configuration, the current which was stored in the primary winding of the transformer during the ON period is no longer delivered to the corresponding output rail, but is injected into the low-voltage rail. The result is to stop supplying the high-voltage output and to rapidly charge up the low-voltage output. The normal-mode regulation (through the TL431) reacts with a drastic increase of the energy demand and a simple zener diode in parallel with the TL431 ensures regulation of the low-voltage rail.

Pulsed Mode Operation Allows SMPS Load Disabling

This reconfiguration has a second impact on SMPS behavior: The high-voltage winding, which is behaving as a current source, is biased at a low-voltage level. Through magnetic coupling, each transformer winding reflects this low voltage relative to its turns ratio. Thus the voltage developed on the 112 V output becomes 11.2 V, the 24 V output becomes 2.4 V and V_{CC} reduces to 1.2 V. It is clear that under such conditions the controller, the MC44608, will stop working. In fact the time out is related to the amount of energy present in the V_{CC} smoothing capacitor (C7 in Fig. 1, again.) When reaching the under-voltage lock-out level (UVLOL) the chip enters into a waiting phase. At the end of that time the chip tries to restart the power supply by activating a V_{CC} capacitor (C7) re-charge process and a new start-up phase. If the secondary reconfiguration is still activated, then the same shut-down sequence will repeat: Regulation of the low-voltage rail, UVLOL of the chip, waiting phase and then another re-start phase. This sequence will repeat so long as the secondary is reconfigured. On the load side of the SMPS, the low-voltage capacitor is charged by successive packets of energy (Pulsed Mode.)

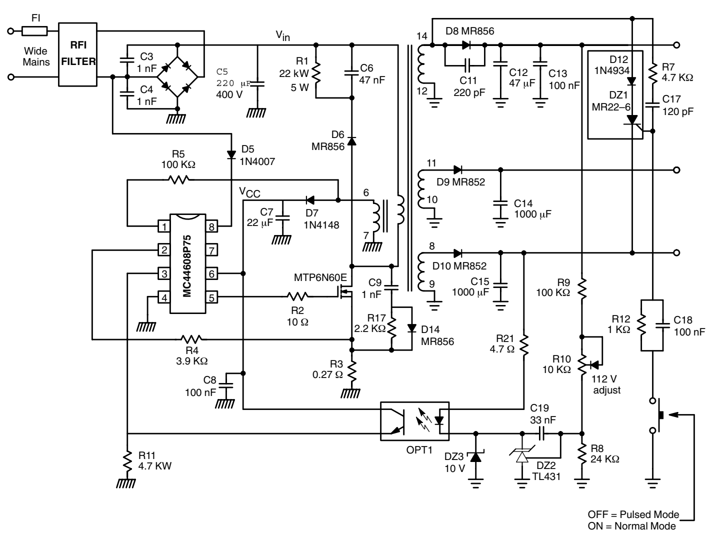

Figure 1. Wide Mains (110-240 Vac) SMPS with Secondary Reconfiguration for Pulsed Mode

The MC44608

The device is a Power MOSFET driver imbedded in a DIP-8 plastic package. It contains all the basic functions of a flyback SMPS controller: An integrated start-up current source with 500 V voltage capability, an internal fixed-frequency oscillator (available at 40, 75 or 100 kHz), a transformer demagnetization-detection system to ensure a discontinuous current mode of operation (can also work in self-oscillating power supply — SOPS — or Quasi-Resonant Mode, a shunt regulator allowing an opto closed-loop regulation, a fully programmable over-current sensing feature used for both modes (Normal and Pulsed Mode), and an over-voltage protection against regulator run-away.

The MC44608 Automatically Selects the Working Mode

This feature allows the power supply to self-detect whether the SMPS secondary side is configured in the Normal Mode or in the Pulsed Mode, performed without the need of any specific access pin on the chip and therefore without additional components. The principle is based on the storage of the regulator's status at the end of every packet of energy. Basically, two kinds of burst mode can occur: A "hiccup mode" corresponding to a secondary overload, or a "pulsed mode" corresponding to the secondary reconfiguration activation

During a hiccup mode the important SMPS feature is to

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APPLICATIONS

GreenLine™ Power Supply
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"survive" — no matter if it is noisy. In that case the power components (transformer, MOSFET and diodes) must remain at an acceptable temperature level. To ensure this status, the working duty cycle is only 10% of the burst period.

The different chip status phases (Fig. 2) show that in the overload mode each switching sequence (every burst) is terminated by the detection of an Over-Current. This OC status is memorized and at the next device start-up the mode will be "Normal." In case of secondary reconfiguration, the regulated level is reached before the termination of the working phase and the status memorized at the end of the working phases is No Over Current (NOC.) At the next device start-up the mode will be "Standby."

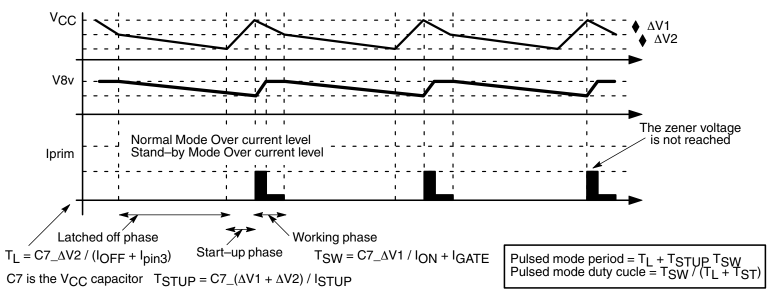

Figure 2.

Dealing with Transformer Acoustical Noise

Power supply design is very often considered an unrewarding task. There are, in fact, some basic reasons why. First, the power supply aspect in a global system is too often studied when the "noble" parts are completed. By definition, the only way to verify compliance of all the system parts is at the end of the project. This is the moment where problems can occur, for example, slight instability on a display or audible noise. If there are insufficient design margins the project can become a nightmare. The MC44608's design should avoid failure due to acoustical noise

The application (Fig. 1, again) is a typical wide mains 80 W TV power supply. The use of the MC44608 only requires four low-cost resistors. The discrete power switch is the ON Semiconductor MTP6N60E energy-rated MOSFET. The clamping and snubbing networks are used to lower the EMI radiation and promote a high-breakdown safety margin on the power switch at higher line voltages. The transformer is provided by Thomson-OREGA and is referenced 10642520-P1. The coil former slotted and the ferrite core is ER 29 x 15. The specification is as follows:

	Turns	Value	Pins
Primary	40	180 mH	1-3
112 V	40		14-12
16 V	6		11-10
8 V	3		9-8
Auxiliary	4		6-7
Iprim peak		3 A	

Figure 3.

The feedback loop uses the opto-technique for primary/secondary isolation purposes. The 112 V output rail is regulated using a resistor divider applied to the TL431. This arrangement produces a current injected in the opto-diode with a value proportional to the d Vout deviation on the 112 V rail. The opto-transistor injects this reflected current into the regulator (pin 3.) An internal shunt regulator converts this current into a voltage, and then a voltage-mode PWM controls the power switch on-state duration.

On the secondary side the reconfiguration is performed using a fast diode in series with a TO-92 thyristor MCR22-6. The network 47 kW - 120 pF allows the thyristor firing synchronously with the TMOS switch-off (rising edge of the flyback voltage.) During the SMPS normal mode the current spike produced by the RC network is directed towards the ground via the standby switch. The standby switch can be controlled by any wake-up block — for example, a microprocessor.

The way the reconfiguration is performed does not create any additional stress in the power supply. The self-thyristor firing is comparable to the secondary diodes switch-on. The effective connection to the low-voltage rail only modifies the level from the high-voltage winding. An additional advantage is that the power switch Drain plateau voltage is significantly reduced during the secondary reconfiguration. In fact, the flyback voltage is divided by the ratio 112/8.

Performance

When working in the active mode, the MC44608 offers the performance of a classical flyback controller. It provides a high safety level thanks to the two distinct Over Voltage Protections: one on V_{CC} and the other directly sensing

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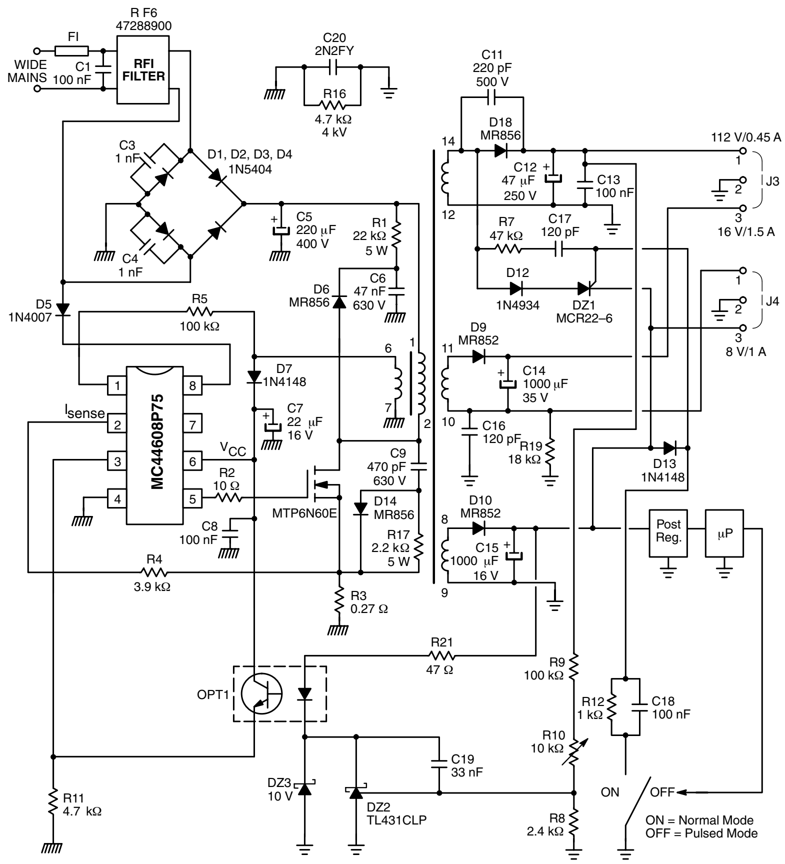
*For additional information on designing with Power Supplies, please order the "**SWITCHMODE Power Supply Reference Manual and Design Guide**" from the ON Semiconductor Literature Distribution Center as SMPSRM/D (See page 27 for ordering details)*

ANALOG INTEGRATED CIRCUITS

Low Standby Power PWM Controller: MC44608

MC44608

- 1 W typical standby power for a 150 W SMPS
- Ideal for TVs, set-top box applications
- Borderline operation prevents continuous conduction mode at startup
- Ease of feedback implementation
- Internal high-voltage startup device
- Available in different switching frequencies: 40, 75 kHZ
- DIP8 package



Typical Application for the MC44608

Available Literature

MC44608/D
PBMC44608/D

CDROM DOWNLOAD HARDCOPY

Pricing to Start at:

MC44608P
$0.96 for 5000 Pcs

GreenLine™ Power Supply from ON Semiconductor

(continued)

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the auxiliary winding voltage. This second OVP is not depending on the V_{CC} capacitor presence and therefore is much quicker. Thanks to the demagnetization detection, a secure discontinuous current mode is ensured improving the output short-circuit behaviour. The global SMPS efficiency is 83%. The input power achieved with the Pulsed Mode of operation exhibits nearly 1 W while delivering 300 mW on the 8 V output. This power level can potentially be considered as being the total system consumption. In addition, the standby mode offers a high safety level by lowering the voltage stress on the power elements. It must be noticed that, thanks to the demagnetization feature, the power supply could run in the so called SOPS mode by properly choosing the T_{on} and T_{off} periods together with the oscillator switching frequency.

by François L'hermite
Applications Engineering, Toulouse

Excerpted from "GreenLine Power Supply from ON Semiconductor" As published on-line at www.chipcenter.com


Something this small shouldn't weigh heavy on your mind.
Our line of analog, logic and discrete components, together with our years of experience, can be found in virtually any electronic product. Including yours.
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APPLICATIONS

New PWM Controller Allows Quasi-Resonant Operation

MC33364 Offline Controller Provides Quasi-Resonant Operation

If resonant mode converters offer the ability to switch at either zero voltage or zero current, the FLYBACK operating in Borderline Conduction Mode (BCM) also represents a possible option in very low-cost designs. Delaying the time at which the MOSFET is re-started, Forces it to switch in the minimum drain-source region (V_{DS} wave close to zero), accordingly reducing the associated capacitive losses and lowering the ElectroMagnetic Interference (EMI) content. Some semiconductor manufacturers improperly call this state quasi-resonant (QR) mode, however valley switching operation is a more accurate description. ON Semiconductor has developed an offline controller, the MC33364, purposely for this so-called QR operation.

Switching at the Minimum Level

Figure 1 depicts the typical architecture of a FLYBACK converter. The main switch is activated via the Pulse Width Modulator (PWM) controller which controls the time it stays ON and OFF. When this power switch closes, the current in the primary ramps-up at a rate given by:

$$\frac{V_{IN}}{L_p}$$

with L_p the primary inductance also called the magnetizing inductance. Because of the diode, no current circulates in the secondary during the ON time. When the PWM dictates the switch opening, the core magnetic field collapses and in attempt to keep the amps-turns circulating, the primary inductance reverses its voltage: D can now conduct and the primary current finds a way to circulate through C_{out} but also R_{load}. The primary ramp-down current is therefore imposed by the reflected V_{out} voltage over L_p: with V_f the diode forward drop. By

$$\frac{(V_{OUT} + V_F)}{L_p \cdot N}$$

adjusting the duty-cycle, the circuit regulates the output voltage at the desired level.

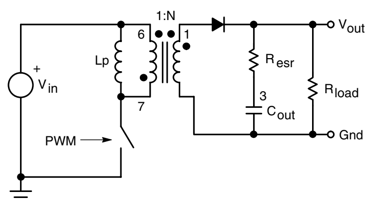

Figure 1. A FLYBACK Converter Implements a Single High-Voltage Switch

When the primary current has completely dried out, the output diode stops conducting and the MOSFET drain is left floating: we are in Discontinuous Conduction Mode (DCM). As a natural effect, a sinusoidal oscillation takes place at a frequency imposed by L_p and all the surrounding parasitic elements noted Clump:

$$F = \frac{1}{2 \cdot \pi \cdot \sqrt{L_p \cdot Clump}}$$

Figure 2 details these typical signals.

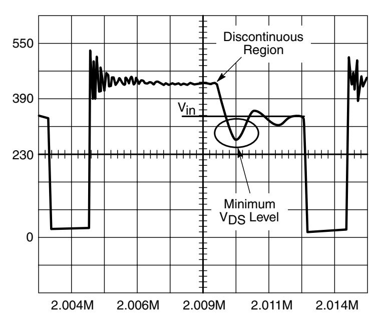

Figure 2. Typical Discontinuous FLYBACK Waveforms

By detecting the moment at which the drain connection passes through its minimum level and re-starting the MOSFET at this time, Valley-switching or QR operation can be implemented. The IC thus imposes DCM and due to QR operation, it naturally lowers the capacitive switching losses defined by:

$$P_{SW} = \frac{1}{2} \cdot Clump \cdot V_{DS}^2 \cdot F_{SW}$$

with Clump the total parasitic capacitance present when the system resonates. The detection of the V_{DS} valley is accomplished through a dedicated auxiliary winding which pictures the core flux activity:

$$V_{aux} = N \cdot \frac{d\varphi}{dt}$$

When the core is fully reset, the auxiliary voltage starts to oscillate as Figure 2 shows. When the sensed signal passes a given threshold (1V typical), the IC re-starts the main switch. If the elements are tailored in order to add a small delay, it is possible to work at the minimum drain voltage. Figure 3 testifies for this nice behavior.

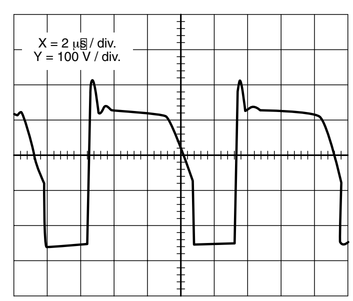

Figure 3. The MC33364 Forces the Minimum Drain-Source Level to Lower the Losses and EMI

A Complete Offline Solution

The MC33364 uses ON Semiconductor's proprietary Very

continued on page 13

Available Literature

MC33364/D

Pricing to Start at:

MC33364*xxx*
$0.79 for 5000 Pcs

To order literature on any of these products, see the Literature Distribution Center Information on page 27.

APPLICATIONS

New PWM Controller Allows Quasi-Resonant Operation

continued

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High-Voltage Integrated Circuit (VHVIC) technology which allows benefits from several key advantages, such as the absence of any external start-up resistor: during the power-on phase, an internal current source charges the IC bulk capacitor. When the controller considers the V_{CC} level to be adequately high, it stops the current source and lets the IC be self supplied from the auxiliary winding. This technique allows the savings of a costly and dissipative element that may considerably hamper the overall efficiency. To avoid the use of an external RC element, an internal 250 ns Leading Edge Blanking (LEB) filters out the classical turn-on current spike. Finally, the variable driver's output impedance permits the direct connection to a MOSFET gate without any other element in series.

As described previously, an internal comparator monitors the activity of the core flux through a dedicated winding and waits until the primary current has fallen down to zero prior to re-start of the switch. The 33364 thus ensures true BCM operation whatever the conditions. This method offers several advantages such as:

1. A less expensive rectifier can be used on the output windings because of the zero current switching which naturally softens the diode turn-off.

2. The Peak drain current is limited to twice the average primary inductor current.

3. By combining the ZCD series resistor with the pin capacitance, a drain-source valley switching can be implemented, further reducing the turn-on losses and the EMI disturbances.

4. By preventing the SMPS from entering the Continuous Conduction Mode (CCM), the MC33364 forces the system to stay a first-order device (in the lower frequency range) whatever the operating conditions (output short, start-up, low mains). The feedback compensation network is thus considerably simplified.

The IC operating in borderline, the switching frequency continuously moves with the input/output conditions. The frequency may be defined by applying the following formula:

$$F_{SW} = \frac{1}{T_{ON} + T_{OFF}} = \frac{1}{L_p \cdot I_{peak} \cdot \left[\frac{1}{V_{IN}} + \frac{1}{(V_{OUT} + V_F) \cdot N}\right]}$$

with L_p the primary inductance, Vin the input voltage, Vout the regulated level, V_f the secondary forward drop and N the primary/secondary ratio. Using this formula and knowing the maximum peak current fixed by the IC ($1V/R_{sense}$ typically), it is possible to calculate the minimum switching frequency desired and thus deduce the value of L_p. The

continued on page 15

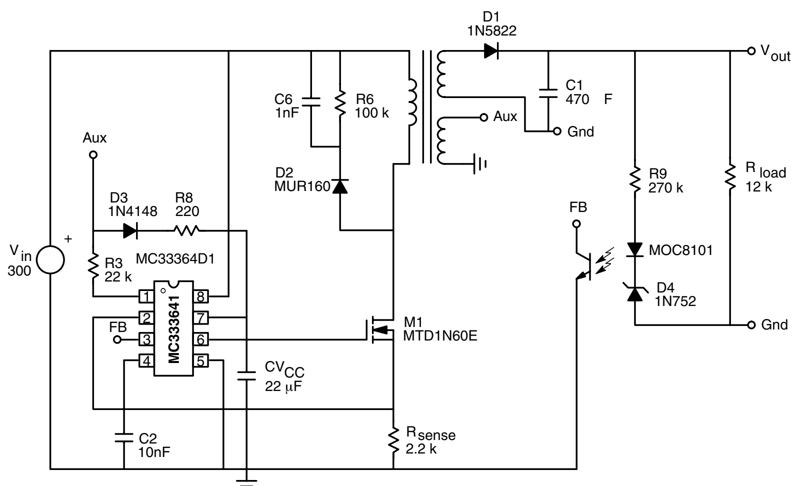


Figure 4. The MC33364 Works as a Borderline Conduction Mode Controller and Requires a Minimal Number of External Components

*For additional information on PWM Controllers, please order the "**Analog Family Tree**" from the ON Semiconductor Literature Distribution Center as SGD504/D (See page 27 for ordering details)*

Power MOSFETs to Use in Conjunction with the MC33364

NTB10N60	**600V** $V_{(BR)DSS}$, **0.75Ω** $R_{DS(on)}$	**TO-220 or D²PAK**
NTD4N60	**600V** $V_{(BR)DSS}$, **2.3Ω** $R_{DS(on)}$	**DPAK**
NTP6N60	**600V** $V_{(BR)DSS}$, **1.1Ω** $R_{DS(on)}$	**TO-220 or D²PAK**
NTP4N60	**600V** $V_{(BR)DSS}$, **2.3Ω** $R_{DS(on)}$	**TO-220**

For additional information on Low Voltage Surface Mount TMOS™ Power MOSFETs, please order Selector Guide SG385/D from the ON Semiconductor Literature Distribution Center (See page 27 for ordering details)

ANALOG INTEGRATED CIRCUITS

Thermal Management and Line Powered Products & LDO's

Available Literature

LM75/D
NPFSLM75/D

MC74/D
NPFSMC74/D

MC33761/D
MC33762/D
MC33765/D
PBMC33765/D

MC33375/D
MC33275/D

CDROM DOWNLOAD HARDCOPY

Pricing to Start at:

LM75DM
$1.24 for 5000 Pcs

MC74A5-50T
$1.05 for 6000 Pcs

MC74A5-33SNTR
$1.05 for 6000 Pcs

MC33761SNTI-025
$0.48 for 3000 Pcs

MC33762DM*xxx*
$1.12 for 4000 Pcs

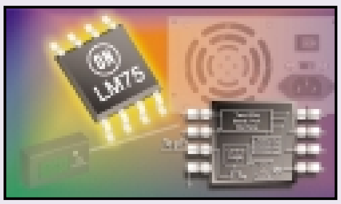
MC33765DT*xxx*
$1.81 for 10,000 Pcs

MC33375D-2.5
$0.56 for 10,000 Pcs

MC33275*xxx*
$0.56 for 10,000 Pcs

2-Wire Serial Temperature Sensor/Serial Digital Temperature Sensors: LM75x and MC74A5x

- **LM75DMx** operates as both a thermostat and temperature event interrupt
- Ideal for high performance CPU's, power supplies, consumer electronics, fire alarms
- May operate as a stand-alone thermostat

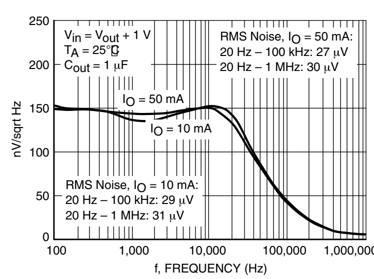


- **MC74A5x** has an accuracy of ±1°C
- SMBus/I2C compatible
- Power consumption 200 µA, 5 µA in standby
- SOT-23-5 lead ideal for thermistor replacement
- Ideal for ambient temperature sensors and low-cost thermostat controls

Low Drop Out Regulators from ON Semiconductor

Ultra Low Noise LDO Tailored for RF Subscribers: MC33761, MC33762, MC33765

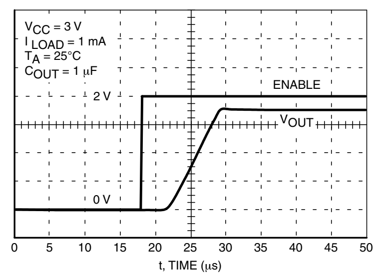
- Incredible noise performance: 40 µRMS 100 Hz - 100 kHz *without* Bypass Capacitor!
- Low spectral noise density: 150 nV/√Hz@100 Hz
- Fast response time from OFF to ON
- Ready for 1 V platforms: enable OK @ 900 mV
- 80 mA nominal output current
- Typical dropout of 90 mV @ 30 mA
- TSOP5 package



Typical Noise Performance of the MC33761

Low Drop Out Regulators: MC33375, MC33275

- Low quiescent current: 300 nA/OFF, 125 µA/ON
- Ideal to supply 1.8 V ICs: DSPs, decoders etc.
- 300 mA output current capability
- 260 mV of typical dropout @ I_O = 300 mA
- Internal temp. shutdown for rugged designs
- Available in different packages: SOT-223/SO-8



MC33375 Response Time to Enable Signal

To order literature on any of these products, see the Literature Distribution Center Information on page 27.

New PWM Controller Allows Quasi-Resonant Operation

(continued)

continued from page 13

peak current of operation is found using

$$P_{in} = \frac{P_{out}}{\eta} = \frac{1}{2} \cdot L_p \cdot I_p^2 \cdot F_{sw}$$

You can now introduce Fsw as previously calculated and simply solve for I_p:

$$I_p = \frac{2 \cdot P_{out} \cdot \left[\frac{1}{V_{IN}} + \frac{1}{(V_{OUT} + V_F) \cdot N} \right]}{\eta}$$

An internal clamp limits the maximum switching frequency to 126 kHz typical.

Conclusion

The ON Semiconductor MC33364 represents the solution of choice when designers wish to implement an extremely low-cost Quasi-Resonant FLYBACK converter. Associated with the MC33341, a complete off-line battery charger can be implemented. Due to a strong output drive current capability, the MC33364 can also drive larger MOSFET's and accordingly ease the design of higher power converters, e.g. for set top box applications or TVs auxiliary supplies.

by Christophe Basso
Applications Engineering, Toulouse

FEATURE

Control Scheme Gives Power Tune-Up

Increasingly higher-performance computing has a direct impact on the power-management portion of the system, especially in portable PCs. To achieve higher operating frequencies and finer geometry shrinks in both microprocessor and memory circuits, voltage levels must decrease and current levels must increase. In most cases, greater functionality will require more power consumption-even with the most sophisticated power-management strategies.

The Semiconductor Industry Association Roadmap, revised in 1999, sets out the advances that will be required to keep up with Moore's Law and the computing and memory forecast for the next 15 years. In power management, several changes will be required in both portable and desktop applications. The operating voltage of portable computers is projected to decrease from 1.5 V in 1999 to 0.3 V in 2014. Furthermore, combinations of voltages will be required to maintain 1.4 W to 2.4 W of power consumption and to power the computer's various subsystems. All this will add to greater design complexity and provide opportunities for different design strategies in power management. For comparison purposes, the decrease in desktop voltages from 1.8 V to 0.6 V is not as drastic as for portable PCs but current levels will increase six times from 50 A to 305 A.

One of the ongoing debates in power management is whether a distributed or an integrated solution is better, but there is no specific rule for deciding. When a critical factor in the new product development plan is time-to-market or time-to-revenue, the most common approach is to use off-the-shelf parts to build a power-management solution, evaluate its performance vs. cost and migrate to an integrated solution later. With the number of different solutions being developed for power management, an application-specific standard product (ASSP) can provide a reasonably good short- and long-term design solution.

by Mike Wang
Sr. Applications Engineer, East Greenwich
EE Times, 28-Apr-2000, 2:27pm EST

Characteristic	1999	2000	2001	2002	2003	2004	2005	2008	2011	2014
Operating Frequency										
Functions per Chip (Gbits)	1.07		2.15		4.29		8.59	24.3	68.7	194
Functions per Chip (M Transistors)	23.8		47.6		95.2		190	539	1,523	4,308
Lithography* (Volume Production in nm)	180	165	150	130	120	110	100	70	50	35
Operating Voltage for Mobile Systems (V)	1.5	1.2	1.2	1.2	1.2	0.9	0.9	0.6	0.5	0.3
Battery Power Hand-Held (W)	1.4	1.6	1.7	2.0	2.1	2.3	2.4	2.0	2.2	2.4
Minimum Logic for Max Performace Vdd (V)	1.8	1.8	1.5	1.5	1.5	1.2	1.2	0.9	0.6	0.6
High-Perfromance Heat Sink (W)	90	100	115	130	140	150	160	170	174	183
Current Calculated	50	56	77	87	93	125	133	189	290	305

*DRAM and ASIC

SIA Roadmap

ON Semiconductor: Dedicated to Developing New Power Management Products

For the complete EE Times story visit the following website:
http://www.eet.com/story/OEG20000428S0030

DISCRETES

Schottky Rectifier in POWERMITE® Package Offers Ultra Low V_F: MBRM130LT3

A new surface mount Powermite Schottky Rectifier from ON Semiconductor offers a unique heatsink design that delivers similar thermal performance to the industry standard SMA package. Referred to as the MBRM130LT3, this 1A, 30V device offers one of the lowest VF specifications (.33V) in the industry. The MBRM130LT3 is also 50 percent smaller in footprint area than the SMA package, which makes it ideal for use in portable and battery powered products such as cellular and cordless phones, battery chargers, notebook computers, printers, PDAs and PCIMCIA cards.

The Schottky Powermite employs the Schottky Barrier principle with a barrier metal and epitaxial construction that produces an optimal tradeoff between forward voltage drop and reverse current. With a VF of .33V at 1A, battery life of battery powered products is extended resulting in higher efficiency. The voltage and current specifications are well suited for reverse battery protection in portable applications. Additionally, this device provides a cost-effective transition to a smaller package from an SMB package for applications with power dissipation at or below 1.5W.

The MBRM130LT3 Schottky rectifier measures only 1.1 mm in height and 8.45 mm2 in area. This compact profile and footprint make it an ideal component for applications, where board space is limited. Typical applications are AC/DC and DC/DC converters, reverse battery protection, and “OR'ing” of multiple supply voltages and any other applications where performance and size are critical.

“Providing packages with smaller footprints is critical to the development of light-weight, portable products,” says Collette Hunt, general manager of ON Semiconductor’s Bipolar Discretes business unit. “ON Semiconductor plans to pursue further development of smaller size packages to accommodate newer technologies in wireless and handheld products and in designs with limited board space.”

Available Literature

MBRM130LT3/D

CDROM DOWNLOAD HARDCOPY

Pricing to Start at:

MBRM130LT3
$0.27 for 12,000 Pcs

ANALOG INTEGRATED CIRCUITS

5V-to-3.3V Dual Input Linear Regulator with Auxiliary Control: CS5233

Our Commitment to the Analog IC Field

Industry First

The CS5233 is the industry’s first 5V-to-3.3V dual input linear regulator with auxiliary control. The two products in this family support loads greater than or equal to loads supported by existing, single input linear regulators with auxiliary control. The CS5233 SOIC supports loads up to 500 mA. The CS5233-3 D^{2}PAK supports loads up to 1.5 A.

ON Semiconductor offers the CS5233 design as a highly integrated solution for powering PC Peripheral Component Interconnect (PCI) cards, and Network Interface Cards (NICs) for PCs that comply with Intel’s Instantly Available PC (IAPC) standard, and in next-generation PCs compliant with Intel’s ATX specification. The ATX bus specification defines two +5 V sources (V_{INPUT}, and $V_{STANDBY}$), and one auxiliary +3.3 V source (3.3 V_{AUX}). These recent standards help servers and PCs fit into high availability, high bandwidth networks.

Added Benefits

Companies that develop PCI cards or NICs can appreciate the extra level of integration provided by the CS5233. Designers at these companies will likely seek to power their PCI card or NIC ASICs at +3.3 V from one of two +5 V sources (V_{INPUT}, or $V_{STANDBY}$), or an auxiliary +3.3 V source (3.3 V_{AUX}).

The alternative to using the CS5233 to select one of two +5 V sources has performance drawbacks. The existing 5V-to-3.3V single input linear regulators with auxiliary control can not provide dual input functionality easily. The possible straightforward

continued on page 18

ANALOG INTEGRATED CIRCUITS

CS5233
continued

CS5233 Features

- 3.3V ± 2% Output Voltage
- Current Limit
- Thermal Shutdown with Hysteresis
- 400µA Reverse Current
- ESD Protected
- Auxiliary Supply Control
- "Glitch Free" Transition Between 3 Sources
- Similar to CS5231-3
- High Output Current Capability
- 1.5A 5-Lead D^2PAK or 500mA 8-Lead SOIC

Available Literature

CS5233/D
CS5231/D

CDROM DOWNLOAD HARDCOPY

Pricing to Start at:

CS5231*xxx*
$0.82 for 10,000 Pcs

CS5233*xxx*
$0.88 for 10,000 Pcs

continued from page 16

solution would involve adding a two diode, wired OR circuit to feed the regulator's single 5 V input. However, this approach has a 5 V to 3.3 V voltage headroom problem associated with an unavoidable forward diode drop, and threshold switching variations associated with the use of two discrete diodes.

Applications

New PCI cards or NICs connect computing power (PCs or servers) to networks at higher and higher data rates (like Gigabit Ethernet). This translates to higher load currents. These same cards need to support communications to and from the network during the powered down state of the power rails to support greater network availability. This makes efficiency important when running from $V_{STANDBY}$ or 3.3 V_{AUX}. The CS5233 supports loads up to 1.5 A to handle the greater power requirements associated with higher bandwidth, and has low ground current and low reverse leakage current to address needs for high efficiency when operating from $V_{STANDBY}$ or 3.3 V_{AUX}. The CS5233 makes sure that the connection between the PC or server to the network is always "on", as it provides continuous and stable 3.3 V power to the PCI card/NIC from the ATX bus as the PC or server switches states from powered-up to powered-down.

Both CS5233 devices have low thermal impedance to manage heat, and thereby increase the ability for designers to keep temperature rises to a minimum, as well as increase reliability. The design has an integrated thermal shutdown to protect itself and loads from overheating situations.

Increased Flexibility

The CS5233 D^2PAK has backward compatibility to the CS5231 D^2PAK, ON Semiconductor's single input linear regulator with auxiliary control. This added flexibility should reduce the amount of effort that it takes a customer to qualify a new PCI card or NIC design.

The CS5233, with its dual input, is positioned for high – end workstation, PCI card/NIC or PC Server NIC applications where great importance is placed on high availability and high bandwidth. The CS5231 is positioned for end – user, PC desktop, NIC applications.

The CS5233-3DPR5, 1.5 A Linear Regulator from ON Semiconductor, is offered in the 5-lead D^2PAK package and the CS5233-3DFR8, 0.5 A Linear Regulator is available in the 8-lead SOIC Narrow package.

by Fred Baechtold
East Greenwich Product Marketing

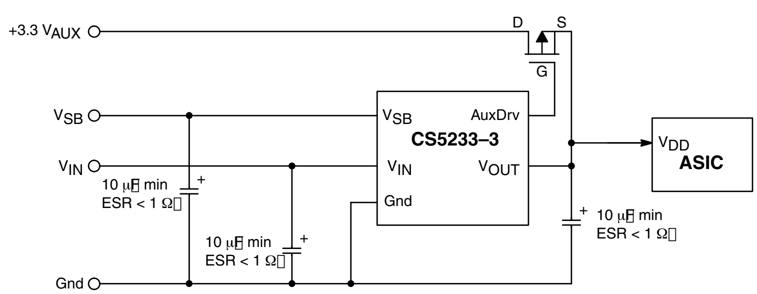
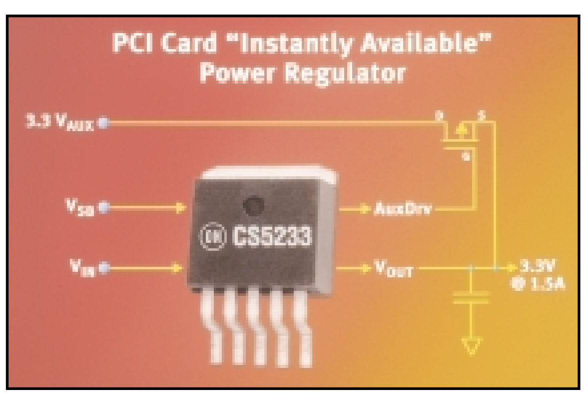


Figure 1. 5V to 3.3V Dual Input Regulator with Auxiliary PFET Power Switch



To order literature on any of these products, see the Literature Distribution Center Information on page 27.

ANALOG INTEGRATED CIRCUITS

Introducing Two SMBus Temperature Sensors from ON Semiconductor: MAX1617 and MC1066

Thermal Management Products for Sophisticated Computing Equipment.

The rapid-fire introduction of new analog products from ON Semiconductor continues with the announcement of two System Management Bus (SMBus) Temperature Sensors. The two products are the MAX1617 and the MC1066. Both are designed to provide thermal protection to Intel's Pentium II™ and other sophisticated CPUs. These devices are also ideal for thermal management in electronic systems including computers, network equipment and power supplies.

Both the MAX1617 and the MC1066, with on-board, integrated temperature sensing diodes, are optimized for monitoring modern high performance CPUs. Communication with both devices is accomplished via the commonly used SMBus, which permits the reading of internal and external temperatures, the programming of threshold set-points and the general configuration of the system. The MAX1617 is low power, with a 70 µA (max) operating, and 10 µA (max) in standby mode with an operating voltage range of 3.0 V to 5.5 V. In addition, the MC1066 is backward compatible with older Advanced Power Management (APM) systems.

Temperature information is converted from the CPU's diode outputs and made available as an eight-bit digital word. Both the MAX1617 and the MC1066 are equipped with independent internal and external threshold set-points which can be configured, with an interrupt signal generated when the actual temperature falls outside the preset threshold windows. For both devices, all registers can be read by the host, and both polled and interrupt-driven systems are supported.

Also included on both devices is a low-power standby mode. Data registers can be accessed during this mode with address selection inputs allowing up to either nine MAX1617s or nine MC1066s to share the same two-wire SMBus for multi-zone monitoring. In the MC1066, however, a separate CRITICAL set-point is provided for 'fail-safe' operation per Advanced Configuration and Power Interface (ACPI) guidelines.

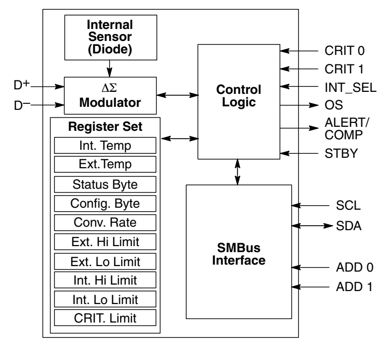
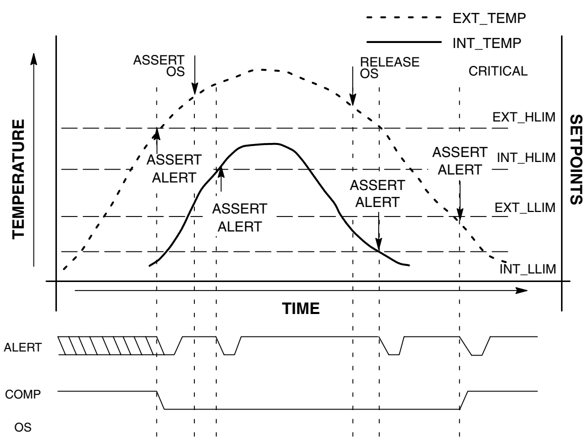


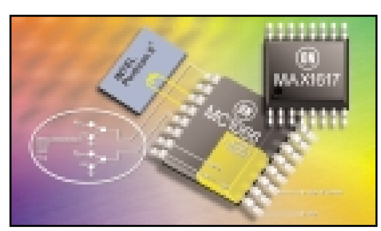
Figure 2. Functional Block Diagram

Offered in a surface mount 16-pin QSOP package, both the MAX1617 and the MC1066 provide a simple, cost effective solution for thermal management of sophisticated computing systems. The ON Semiconductor MAX1617DBR2 is a direct drop in replacement for Maxim's MAX1617MEE and Telcom's TCM1617MQR, with the MC1066DBR2 providing the added functionality and compliance to ACPI standard specifications.



Note: This diagram implies that the appropriate setpoint is moved, temporarily, after each ALERT event to suppress re–assertion of ALERT immediately after the ARA/de–assertion.

Figure 1.



MAX1617 MC1066 SMBus Temperature Sensors

Available Literature

MAX1617/D
NPFSMAX1617/D
MC1066/D
NPFSMC1066/D

CDROM DOWNLOAD HARDCOPY

Pricing to Start at:

MAX1617*xxx*
$2.39 for 10,000 Pcs

MC1066*xxx*
$2.39 for 10,000 Pcs

Logic One-Gate Family Brings Small to a New Low

Available Literature

DLD601/D
AND8004/D
AND8018/D
Individual Data Sheets*

Each individual One-Gate device has an orderable Data Sheet available on both the* ***onsemi.com* *web-site and via the Literature Distribution Center.*

To order individual Data Sheets, simply add a "/D" to the end of the device number shown in Table 1 on page 21. For example, a Data Sheet for the MC74VHC1G00 would be MC74VHC1G00/D.

LOGIC

The Retreat of Silicon?

Most of the attention being paid to the march of silicon is focused on the mega-chips. But, with the latest in less-is-more solutions, things might be about to change.

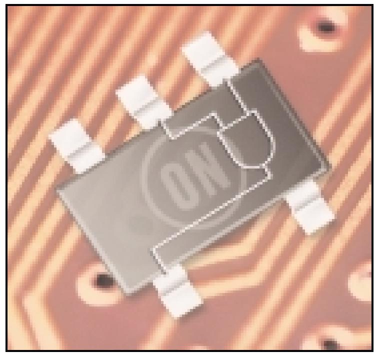
The march of silicon is a wonderful thing that has bred applications faster than a bunch of bunnies that overdosed on Viagra. It's no surprise to find silicon permeating our lives. It's simple Econ 101. How rare is it to encounter more-for-less situations or a free lunch? Market signals, indeed, a giant flashing neon design-me-in sign.

After all, more-for-less pretty much sums up Moore's Law. Is there an end in sight – a silicon "wall," if you will? It's not hard to imagine some little roadblock (for example, the laws of physics) putting a damper on things. I share the feeling of Gordon Moore, who I once heard speak on the subject of a "wall." He said he quit predicting it, because he was wrong so many times. Yes, there is a wall, but we aren't hitting it tomorrow…

Dis-Integration

Naturally, all these laws pose challenges for law abiding designers. Of course, most of the attention is focused on the leading-edge stuff. How do you design a chip with a zillion gates, much less test it or get any reassurance that it will do what you think it's supposed to do? For chip designers, the challenge becomes less of "how do I fit it all in?" and more of "how do I fill it all up?"

Less noticeable is the interesting phenomenon of chips falling off the trailing edge of Moore's and Gelbach's laws. Have you tried to buy a 16-MB DRAM lately? What's the price compared to a 64-MB DRAM? System designers must become economically aware, with enough merchant market savvy to design parts at (not above) the knee of the bang-per-buck curve.



"*Honey, I shrunk the TTL.*" The One-Gate logic from ON Semiconductor achieves a new low in silicon integration.

Thus, with the more-for-less mentality firmly entrenched, you wouldn't expect to see an IC company tooting its horn over a less-is-more solution. But, that's exactly what ON Semiconductor is doing.

For those of you who don't keep up with business machinations, ON is a recent spinoff of Motorola's analog and discrete logic group. With global sales topping nearly $2 billion, 8.7% market share, and 14,000 employees, it's a significant player. The chairman of the board is none other than Curtis Crawford, top gun at Zilog. It's more than just a coincidence, both ON and Zilog (and recently, Segate) are taken-private companies funded by an outfit known as the Texas Pacific Group.

One Gate Too Far

Every designer has faced the dilemma. You've finally finished your beautifully crafted, artfully elegant, masterfully minimalist design when, "Oh, no! Another NAND gate is needed!"

Actually, these types of gotchas can be a fun challenge, presuming you've got time for a bit of head scratching. All designers have a war story about the time they ended up behind enemy lines – a gate, bit of memory, or I/O pin – too far. Courage, cleverness, and can-do spirit prevail in the form of some inspired hack-around. Victory for our side!

But, save the heroics, because the One-Gate (OG) is here. That's right, I'm talking about a catalog of Moore's lawbreakers from ON that integrate a whopping 10^0 gates.

So far, the OG lineup consists of a couple dozen parts (see parts list), encompassing the most popular SSI 74xx-type logic functions.

Let's start by taking a closer look at the 74VHC1GT00 one-gate NAND chip shown in Figure 1. Hey, this high-tech writing gig isn't so hard after all.

In terms of the TTL flavor, the

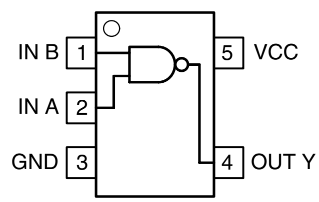


Figure 1. When It Comes to a One-Gate NAND Chip, Less Is, in Fact, Less

'1GT00 is based on the VHC-logic family, which is a middle-of-the-road technology that covers a lot of application territory. What it gives away in speed (prop delay of 3 to 5 ns at room temperature and 10 to 15 ns at 85°C), it more than makes up for in versatility.

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LOGIC

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The main advantage is that the chips are voltage agnostic when it comes to supply and input/output mixing and matching. Guaranteed operating supply voltage (V_{CC}) spans a wide 2- to 6-V range. As usual, speed derates as the supply voltage is reduced (e.g., typical room temperature prop delay is 3.6 ns at 5 V_{CC} and 5.5 ns at 3.3 V_{CC}).

Inputs feature TTL thresholds (a maximum of V_{IL} 0.8 V and a mini-mum of V_{IH} 2 V), so the OG can listen to CMOS or TTL as well. Better yet, input protection logic provides over-voltage tolerance. Not only does this protect the inputs up to 7 V regardless of supply, but it also enables an OG to serve as a logic-level translator in mixed voltage applications. For instance, you can connect a 5 V input to an OG running on a 3 V sup-ply to achieve 5 V in and 3 V out level translation.

Outputs are CMOS-compatible semi-rail-to-rail (i.e., V_{OH} > 0.8 V_{CC} and V_{IL} < 0.1 V_{CC} fully loaded at I_{OL} = 8 mA). That means, like the input side, the OG outputs are TTL and CMOS bilingual. One nice touch is that the outputs aren't bothered by a voltage (up to 5.5 V) hanging around when power is shut off (i.e., V_{CC} = 0 V). That's useful for hot-plug designs or those that use multiple independent on/off power supplies, a common technique for extending battery life.

Not that your battery is even going to know an OG is there with room temperature quiescent supply current of only 2 µA. Remember that, as with all CMOS, this minimum spec requires the input be held at one of the rails. Power consumption could jump to more than one milliamp if you leave the input floating.

Layout Lament

Using a one-gate chip isn't only about a penny-pinching solution to a one-gate shortage… The real virtue of OG isn't price per gate, but rather place per gate…

by Tom Cantrell

Excerpted from the article "The Retreat of Silicon?" at chipcenter.com. For the complete article see the Chipcenter website
http://www.chipcenter.com/circuitcellar/april00/pdf/c0300supdf.pdf

Tom Cantrell has been working on chip, board, and system design and marketing in Silicon Valley for more than ten years. You may reach him by e-mail at tom.cantrell@circuit cellar. com, by telephone at (510) 657-0264, or by fax at (510) 657-5441

The Retreat of Silicon? Logic One-Gate Family
continued

Pricing
For detailed pricing information on One-Gate devices, contact your local ON Semiconductor Representative

Device	Function	Device	Function
MC74VHC1G00	2-Input NAND Gate	MC74VHC1GT00	2-Input NAND Gate, CMOS Level Shift
MC74VHC1G01	2-Input NAND, Open Drain Output	MC74VHC1GT02	2-Input NOR Gate, CMOS Level Shift
MC74VHC1G02	2-Input NOR Gate	MC74VHC1GT04	Inverting Buffer, CMOS Level Shift
MC74VHC1G03	2-Input NOR, Open Drain Output	MC74VHC1GT14	Schmitt-Trigger Inverter, CMOS Level Shift
MC74VHC1G04	Inverter	MC74VHC1GT50	Noninverting Buffer, CMOS Level Shift
MC74VHC1G05	Inverter, Open Drain Output	MC74VHC1GT66	Analog Switch, CMOS Level Shift
MC74VHC1G07	Noninverting Buffer, Open Drain	MC74VHC1GT86	2-Input XOR Gate, CMOS Level Shift
MC74VHC1G08	2-Input AND Gate	MC74VHC1GT125	Noninverting 3-State Buffer, CMOS Level Shift
MC74VHC1G09	2-Input AND, Open Drain Output	MC74VHC1GT126	Noninverting 3-State Buffer, CMOS Level Shift
MC74VHC1G14	Schmitt-Trigger Inverter	MC74VHC1GU04	Unbuffered Inverter
MC74VHC1G32	2-Input OR Gate	MC74HC1G00	2-Input NAND Gate
MC74VHC1G50	Buffer	MC74HC1G02	2-Input NOR Gate
MC74VHC1G66	Analog Switch	MC74HC1G04	Inverter
MC74VHC1G86	2-Input XOR Gate	MC74HC1G08	2-Input AND Gate
MC74VHC1G125	Noninverting 3-State Buffer	MC74HC1G14	Schmitt-Trigger Inverter
MC74VHC1G126	Noninverting 3-State Buffer	MC74HC1G32	2-Input OR Gate
MC74VHC1G132	2-Input NAND Schmitt-Trigger	MC74HC1GU04	Unbuffered Inverter
MC74VHC1G135	2-Input NAND Schmitt-Trigger, Open Drain		

TABLE 1. Currently Available One-Gate Devices

LOGIC

New Clock Distribution Devices from the Low Voltage ECLinPS Plus™ Line (LVEP)

Advanced Timing Solutions from Logic

New and improved Clock (or Data) Distribution Devices are available for Low Voltage systems requiring minimum skews, the fastest edges, and the most versatile compatibility with various types of signal levels. With increased demands on designers, clocks and critical timing signals will require precise edge placement and the most accurate propagation possible, which can be resolved with the Low Voltage ECLinPS Plus™ line of clock distribution devices. Clock distribution trees can provide all boards and subsystems with elegant and exact timing solutions.

LOWER Skews

The big news is in Skew reduction! Skew is the variation found between part-to-part and between output-to-output in any given part (Figure 2). Less is better and we offer much less:

MC100LVEP210FA vs. MC100LVE210FA

- 220 to 110 pS in part-to-part skew - *A 50% reduction!*
- 50 to 35 pS in output-to-output skew - *A 30% reduction!*

MC100LVEP111FA vs. MC100LVE111FA

- 200 to 100 pS in part-to-part skew - *A 50% reduction!*
- 50 to 25 pS in output-to-output skew - *A 50% reduction!*

MC100LVEP14DT vs. MC100LVEL14DW

- 50 to 25 pS in output-to-output skew - *A 50% reduction!*

All designs will substantially benefit from this significant improvement. For systems designers, this frees up more signal time for all other components to use or simply to allow the entire process to execute faster!

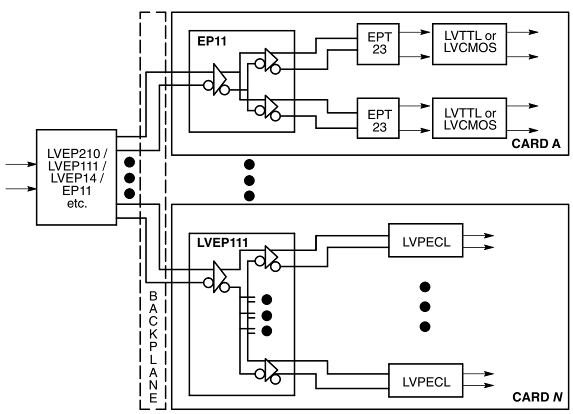

Figure 1. Clock Distribution Tree and Subsystems Boards

Device	Function	Package	Pins
MC100EP11D	Differential 2:1 Fanout Driver	SOIC	8
MC100LVEP14DT	Differential 2:1 Multiplexer Input Selector with 1-to-5 Fanout Driver	TSSOP	20
MC100LVEP111FA*	Differential 2:1 Multiplexer Input Selector with 1-to-10 Fanout Driver	TQFP	32
MC100EP139DT, MC100EP139DW	Differential ÷2/4 and ÷4/5/6 Divider Inputs Each with a 1:2 Fanout Driver	TSSOP SOIC	20 20
MC100LVEP210FA	Differential Dual 1-to-5 Drivers	TQFP	32

* The MC100LVEP111FA features an additional output with a 1:10 fanout compared to the MC100LVE111FA with a fanout of 1:9 outputs.

Table 1. New Clock Distribution Devices

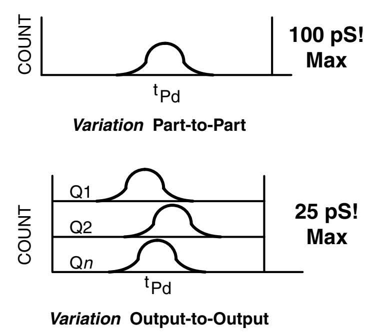

Figure 2. Skew Variation Part-to-Part and Output-to-Output

New Lower Voltage: 2.5 V

Lower operating voltage is a premier feature for the new LVEP (Low Voltage ECLinPS Plus) series creating opportunity to participate in the newer Low Voltage Systems Designs. In these new systems, signal levels remain compatible throughout the range of low

continued on page 23

Available Literature

BR1513/D

Pricing to Start at:

MC100EP11D
$7.67 for 2548 Pcs

MC100LVEP14DT
$15.10 for 5025 Pcs

MC100LVEP111FA
$10.72 for 5000 Pcs

MC100EP139DT
$11.78 for 5025 Pcs

MC100EP139DW
$11.78 for 5016 Pcs

MC100LVEP210FA
$10.72 for 5000 Pcs

To order literature on any of these products, see the Literature Distribution Center Information on page 27.

LOGIC

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voltage V_{CC}: 3.0, 3.3, 3.5 and 3.8 volt supply. Both LVECL and LVPECL operation modes are accommodated. At a V_{CC} of 2.5, the outputs may be terminated directly to Ground (V_{EE}) with the typical trace impedance resistors of 500 ohms.

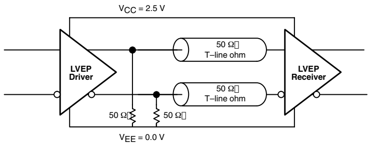


Figure 3. Typical 2.5 V_{CC} Low Voltage ECLinPS Plus Configuration

HSTL LVDS Compatible

The versatility of the inputs has an added feature. They are now capable of accepting either HSTL or LVPECL level signals. This expanded compatibility extends over the V_{CC} supply range of 2.5 to 3.8 volts. Each differential input pair may be either HSTL or LVPECL allowing new variation in system configurations.

LVDS level Compatibility

By adding a second or a double termination to the LVEL output

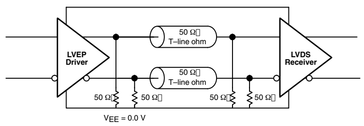


Figure 4. Typical 2.5 V_{CC} Low Voltage ECLinPS Plus to LVDS Configuration

signal line, level and Vswing compatibility to a LVDS receiver is accomplished:

Faster EDGES

The ECLinPS Plus (EP) series boasts impressive gains in output rise and fall edge times:

MC10EP11D
vs.
MC100LVEL11D

31% max. 41% min improvement!

MC100LVEP111FA
vs.
MC100LVE111FA

37% max. 35% min improvement!

MC100LVEP210FA
vs.
MC100LVE210FA

42% max. 50% min improvement!

MC100EP139
vs.
MC100LVEL39DW

46% max. 45% min improvement!

Faster edges are the critical factor in precision timing and edge placement. The rise and fall advantage gives the designer greater safety margins and richer guardbands in general.

Wider Flexibility

Faster operation and finer edge placement are the most valued parameters in today's evolving CLOCK systems. Better and smaller board spins are teamed with accelerated processors and subsystem components to challenge Low Voltage ECLinPS Plus line devices – the best in Clock Distribution – and these new devices deliver lower skews, improved compatibility, faster edges, and lowered operating supply voltages.

by Paul Shockman
Logic Applications Engineering

New Clock Distribution Devices from the Low Voltage ECLinPS Plus™ Line
continued

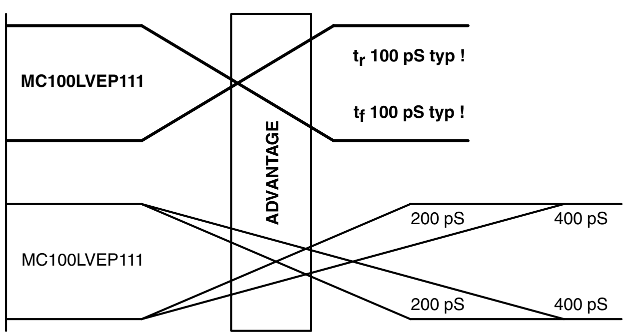


Figure 5. Faster Edges

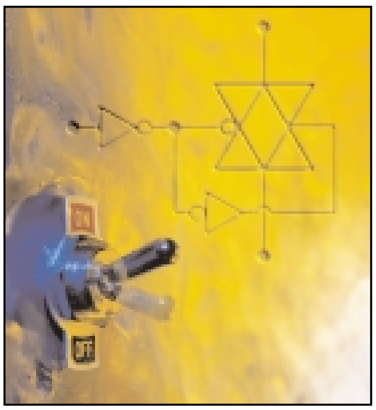
LOGIC

ON Semiconductor Introduces New High-Performance CMOS Analog Switches

Features

- Impressive Resistance Values, Typically Less than 15Ω at 5V (vs. 80Ω to 100Ω industry standard)
- One-Gate Version MC74VHC1G66 MC74VHC1GT66
- Single Voltage Supply, Standard 2V to 6V
- Higher Operating Frequency

Eleven new devices have recently been introduced by ON Semiconductor, adding to its large array of analog switches, already available. The new devices are offered in multi-gate and one-gate configurations. This latest offering entails a low-resistance, high frequency response product, providing improved performance for a lower cost to the designer.



Less than 15-Ohms Resistance

The eleven new analog switches include the MC74LVX4066/8051/8053, their TTL-Compatible versions (MC74LVXT4066/8051/8053), and two new one-gate devices – M7CVHC1G66/1GT66, and three new VHC products – the MC74VHC4051, 4052 and 4053. The new devices compliment the standard offering of analog switches, multiplexers, and demultiplexers.

Designed as either a single-voltage supply from two to six volts for the standard parts or five volts for the TTL-compatible "T" versions, the additions will suit many applications. Typical resistance values are less than 15 ohms for many of the devices when operating at five volts compared to the industry-standard of 80 ohms to 100 ohms. The multi-gate products are available in both 16-lead SOIC as well as TSSOP packages, while the single-gate devices are available in industry-standard SC-88a, five-lead packages.

Ideal for Wireless, Analog or Digital

ON Semiconductor's new high-performance portfolio can be utilized in many diverse, applications and markets, including wireless, computing, and standard telecommunication systems. The devices primarily accomplish the switching, multiplexing, and demultiplexing of both analog and digital signals. Many so-called digital signals are actually quasi-analog in nature, such as frequency shift key (FSK), phase-shift key (PSK), quadrature amplitude modulation (QAM), code division multiplex (CDMA), and time division multiplexing (TDMA). As a result, they need to share the decoding from several different input sources, with minimum distortion to the signal. And in consumer products, switching between two or more analog sources is a constant requirement.

As an example of an application (Figure 1), one of eight sources could be selected to decode for a Dolby Digital or DTS decoder. A stereo receiver would likely have a single audio decoder, but would need to switch between up to eight inputs to be connected to a single (potentially costly) decoder. The demultiplexer is not only low cost but also minimizes the loss and distortion that is added to the circuit. The frequency required for an example such as the one pictured falls in the 10 MHz range.

Very High-Speed CMOS Offerings

Among the eleven analog-switch family additions, ON Semiconductor is offering three new Very High Speed CMOS (VHC) devices – the MC74VHC4051, 4052, and 4053 provide improved performance over previous offerings. These new VHC devices allow operation with both positive and negative supplies. This feature allows for switching an

continued on page 25

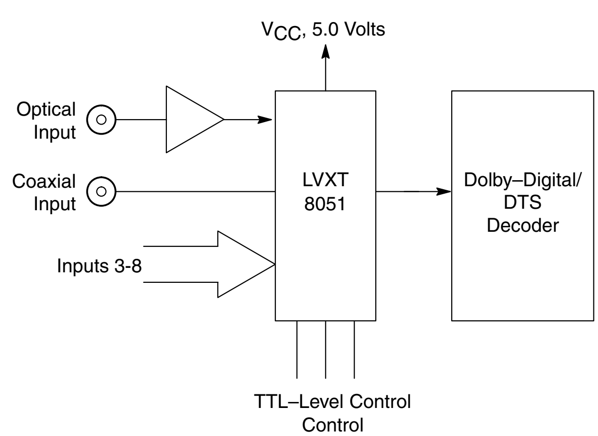


Figure 1.

To order literature on any of these products, see the Literature Distribution Center Information on page 27.

LOGIC

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AC waveform that is centered approximately zero volts with no coupling capacitors.

A ±3.3 V-supply allows for a 5 V peak-to-peak waveform, with LVTTL/CMOS compatibility. The DC level is preserved for the case of video switching. The VHC4053 is especially ideal for switching beyond 30 MHz. The diagram (Figure 2 on page <None>) illustrates switching two audio channels from three sources and three video channels simultaneously. The signal levels may be ±2.5 volts.

Two Dynamic New One-Gate CMOS

Two new single-gate products were also introduced into ON Semiconductor's advanced, sub-micron VHC family-the MC74VHC1G66 and MC74VHC1GT66. These new devices offer a single analog-switch function and impressive AC-performance levels. Figure 3 illustrates a way to change a time constant in a loop filter application for fast "attack" stable "hold" using the MC74VHC1G66.

by Fred Zlotnick
Logic Applications Engineering

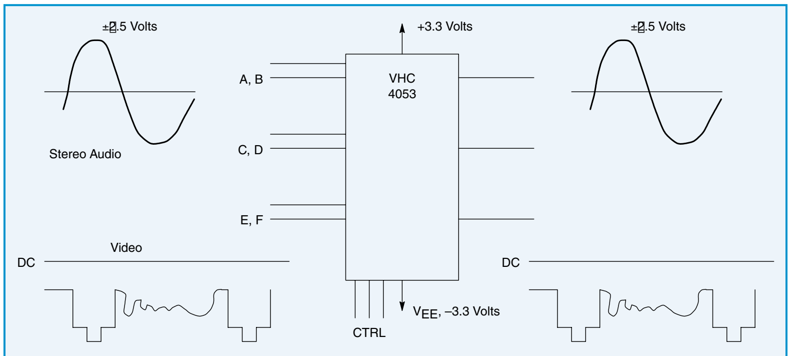

Figure 2.

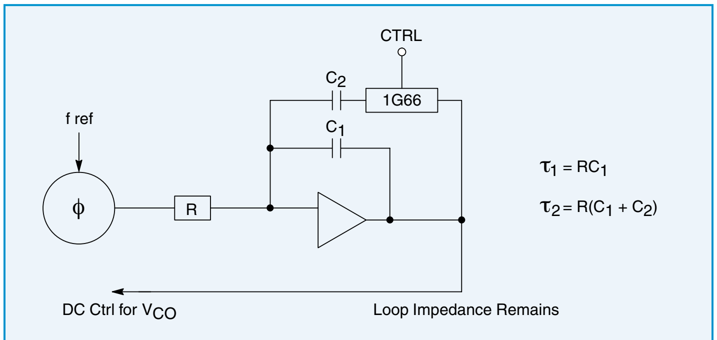

Figure 3.

Analog Switches
continued

Available Literature
BRD8007/D
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Pricing
For detailed pricing information on Analog Switches, contact your local ON Semiconductor Representative

ANALOG INTEGRATED CIRCUITS

Three-Phase Buck Controller with Integrated Gate Drivers: CS5303

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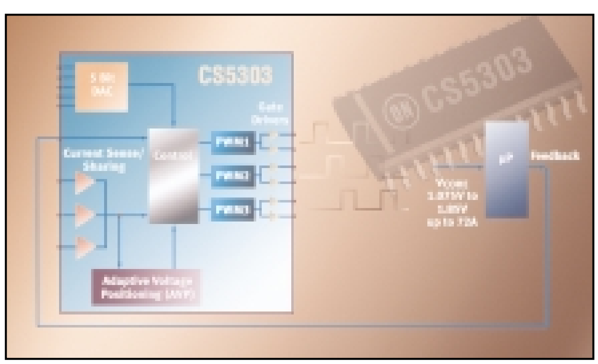
- 3.3 V, 1 mA Reference Output
- 5 V and/or 12 V Operation
- On/Off Control (through COMP Pin)



CS5303 Buck Controller

Available Literature
CS5303/D
CDROM DOWNLOAD HARDCOPY

Pricing to Start at:
CS5303*xxx*
$4.81 for 10,000 Pcs

DISCRETES

MOS-Gated Division Introduces New Generation of High Voltage MOSFETs

New High Voltage MOSFETs Fill Competitors' Sockets

In late March, the next generation of high voltage MOSFETs to supply the power supply, industrial control, and general-purpose market were launched from ON Semiconductor. Fifteen new devices (see insert below), covering the 400-600 volt ranges, will be introduced throughout the second quarter of 2000.

The MOS-Gated next generation high voltage technology offers many features and benefits. These devices have up to 30% $R_{DS(on)}$ reduction, improved UIS (unclamped inductive switching) capability, and reduced gate charge from current high voltage technologies. Reduced gate charge results in lower switching loss and more efficient power conversion. Specification points previously available only in TO-220 and D^{2}PAK packages are now available in the space saving surface mount DPAK package. Similarly, this advanced silicon technology enables replacement of parts existing in TO-218, TO-247 and TO-263 with parts contained in TO-220 and D^{2}PAK packages.

"Our new high voltage technology allows ON Semiconductor to become a more significant player in the highly competitive high voltage MOSFET markets. This is great news for our customers," says John Trice, MOS-Gated Division Marketing Director.

by Don Zaremba
MOS-Gated Product Marketing
and
Bob Forness
Product Launch Manager

Each individual MOSFET device has an orderable Data Sheet available on both the* **onsemi.com *web-site and via the Literature Distribution Center.*

To order individual Data Sheets, simply add a "/D" to the end of the device number shown in Tables 1 and 2. For example, a Data Sheet for the NTP10N60 would be NTP10N60/D.

Device	Description	Critical Parameters	Package
NTP10N60	NCh 600V MOSFET	600V, 750 mohm@10V	TO-220
NTB10N60	NCh 600V MOSFET	600V, 750 mohm@10V	D^{2}PAK
NTD4N60	NCh 600V MOSFET	600V, 2.3 ohm@10V	DPAK
NTP6N60/IRFBC40	NCh 600V MOSFET	600V, 1.2 ohm@10V	TO-220
NTB6N60	NCh 600V MOSFET	600V, 1.2 ohm@10V	D^{2}PAK
NTP15N40	NCh 400V MOSFET	400V, 260 mohm@10V	TO-220
NTB15N40	NCh 400V MOSFET	400V, 260 mohm@10V	D^{2}PAK
NTP12N50	NCh 500V MOSFET	500V, 410 mohm@10V	TO-220
NTB12N50	NCh 500V MOSFET	500V, 410 mohm@10V	D^{2}PAK
NTD5N50	NCh 500V MOSFET	500V, 1.8 ohm@10V	DPAK
NTD6N40	NCh 400V MOSFET	400V, 1.1 ohm@10V	DPAK
NTP8N50/IRF840	NCh 500V MOSFET	500V, 800 mohm@10V	TO-220
NTB8N50	NCh 500V MOSFET	500V, 800 mohm@10V	D^{2}PAK
NTP10N40/IRF740	NCh 400V MOSFET	400V, 500 mohm@10V	TO-220
NTB10N40	NCh 400V MOSFET	400V, 500 mohm@10V	D^{2}PAK

Table 1. New MOS-Gated High Voltage Portfolio

Competitor	Device	Package	$R_{DS(on)}$ (ohms)	Id(cont) (amps)	ON Substitute in DPAK Device	$R_{DS(on)}$	Id(cont)
International	IRFBC30	TO-220	2.2	3.6	NTD4N60	2.3	4.5
Rectifier	IRFIBC30G	TO-220FP	2.2	2.5	NTD4N60	2.3	4.5
	IRFPC30	TO-3P	2.2	4.3	NTD4N60	2.3	4.5
	IRFBC30S	D2PAK	2.2	3.6	NTD4N60	2.3	4.5
	IRFBC30A	TO-220	2.2	3.6	NTD4N60	2.3	4.5
	IRFBC30AS	D2PAK	2.2	3.6	NTD4N60	2.3	4.5
SGS-Thomson	STB5NB60	D2PAK	2.0	5.0	NTD4N60	2.3	4.5
	STP5NB60	TO-220	2.0	5.3	NTD4N60	2.3	4.5
	IRFBC30	TO-220	2.2	3.6	NTD4N60	2.3	4.5
	STP5NB60FP	TO-220FP	2.0	3.0	NTD4N60	2.3	4.5

Table 2. Example of Potential Package Shrink with New ON Semiconductor DPAK Parts

To order literature on any of these products, see the Literature Distribution Center Information on page 27.

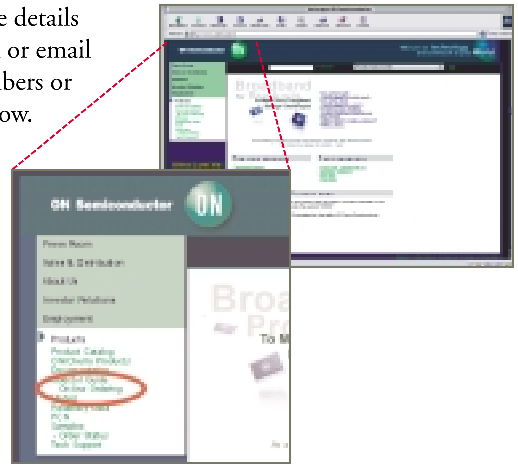
TO ORDER LITERATURE

ON Semiconductor's Global Literature Distribution Center

Our Customer Service Team is ready to fulfill your orders in five languages for data sheets, data books, selector guides, catalogs, brochures, and any other stocked items in print or on an personalized ON Semiconductor ON-Demand™ CDROM.

Dedicated ON Semiconductor Customer Service Representatives are available from 7:00am to 5:00pm MST, Monday through Friday, as well as during European and Asian local times (see details below). You may call, fax or email your requests to the numbers or email addresses listed below.

You can also order your literature or CDROMs directly from the **onsemi.com** website by clicking the "On-line Ordering" link in the left-hand navigation bar.



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N. American Technical Support: 800-282-9855 Toll Free USA/Canada

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English Phone: (+1) 303-308-7142 (M-F 12:00pm to 5:00pm UK Time)
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ASIA/PACIFIC: LDC for ON Semiconductor - Asia Support
Phone: 303-675-2121 (T-F 9:00am to 1:00pm Hong Kong Time)
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001-800-4422-3781
Email: ONlit-asia@hibbertco.com

JAPAN: ON Semiconductor, Japan Customer Focus Center
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Phone: 81-3-5740-2745
Email: r14525@onsemi.com

ON Semiconductor Website: http://onsemi.com

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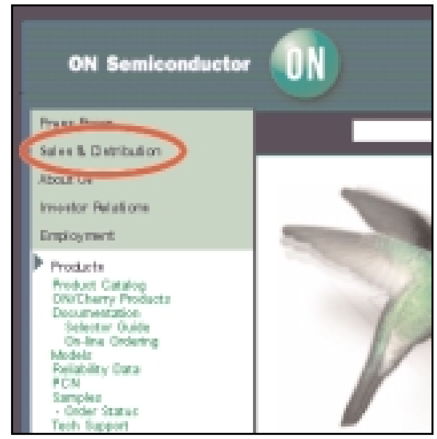

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