

## DUAL REGULATORS SIMPLIFY MICRO SYSTEM SUPPLY DESIGN

Combining two 5 V regulators and a reset circuit on a single chip, special purpose regulator chips simplify the design of power supplies for microprocessor systems incorporating battery backup RAMs or shadow-type NV RAMs.

Power supplies for microprocessor systems are often complicated by the need to take care of the special requirements of non-volatile read/write memory. Where battery backup CMOS RAMs are used, for example, it is important to ensure that the RAMs are disabled when the primary supply is removed. And when shadow-type NV memory is included the backup transfer must be initiated and completed when the supply is interrupted. Designed specifically for such applications, the SGS-THOMSON Microelectronics L4901, and L4902 dual voltage regulators combine two 5 V regulators plus a reset circuit on a single chip, simplifying the designer's task.

Assembled in the SGS-THOMSON Heptawatt [TM] 7-lead package, the L4901 and L4902 contain separate voltage regulators rated at 5 V/300 mA (the "V1" output) and 5 V/400 mA (the "V2" output).

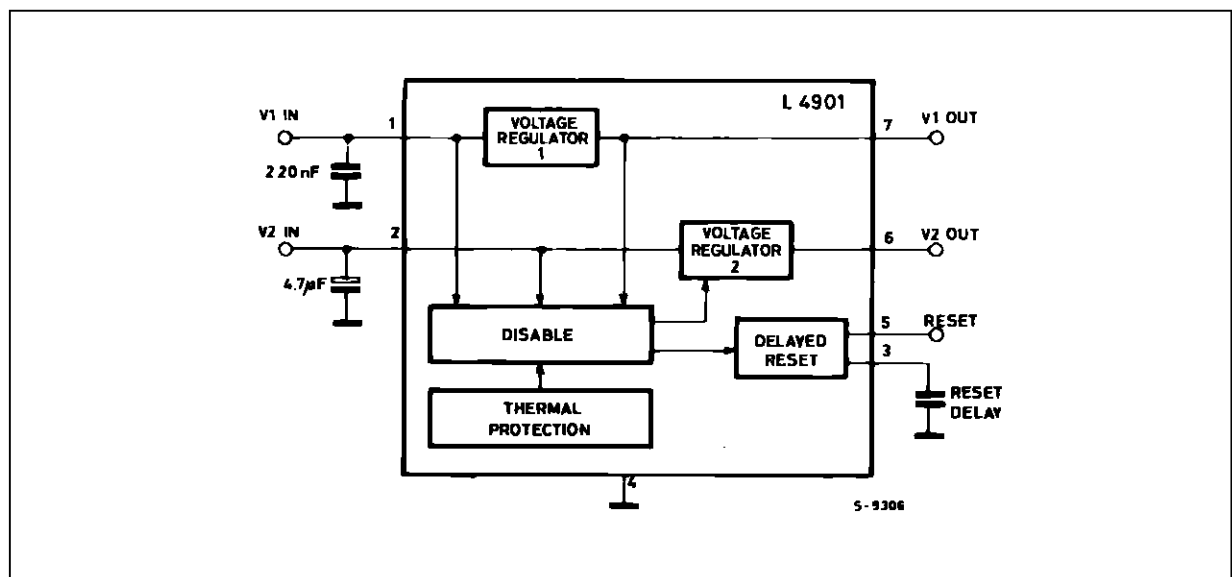
Both the V1 and V2 regulators have an output voltage precision of  $\pm 2\%$  and include protection

against output short circuits and 60 V input transients. Also included on the chip is a reset circuit with externally programmable timing which depends on the input voltage and the output of the V1 regulator. Functionally, the two devices are identical except that the L4901 has separate inputs to the two regulators and the L4902 has a common input plus a disable input which controls the V2 output (fig. 1).

Generally the V1 regulator is used to supply circuits which must be powered continuously - volatile memory, a time-of-day clock and so on - while the V2 output supplies other 5 V circuits which may be powered down when the equipment is inactive.

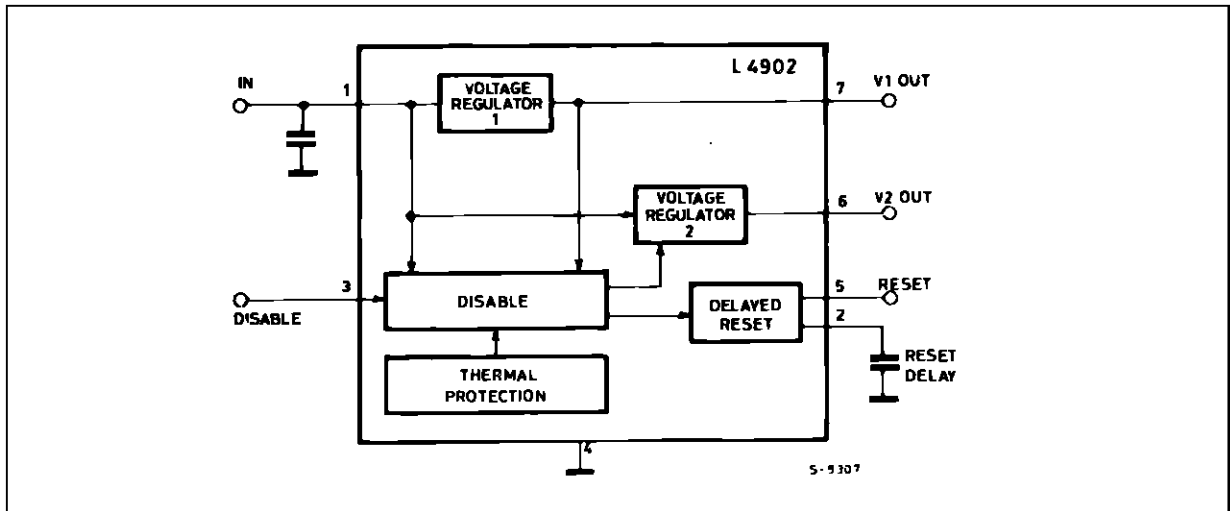
The V1 output features a very low leakage current at the output - less than 1  $\mu\text{A}$  - to allow the use a backup battery. The V1 regulator also features a low quiescent current at the input (0.6 mA typical) to minimize battery drain in applications where the V1 regulator is permanently connected to a battery supply.

**Figure 1a :** TWO 5V OUTPUTS - The L4901 Dual Regulator Provides 300 mA and 400 mA 5 V Outputs and Includes a Microprocessor Reset Function. This Device is Ideal for Microprocessor Systems with Battery Backup or Shadow RAM.

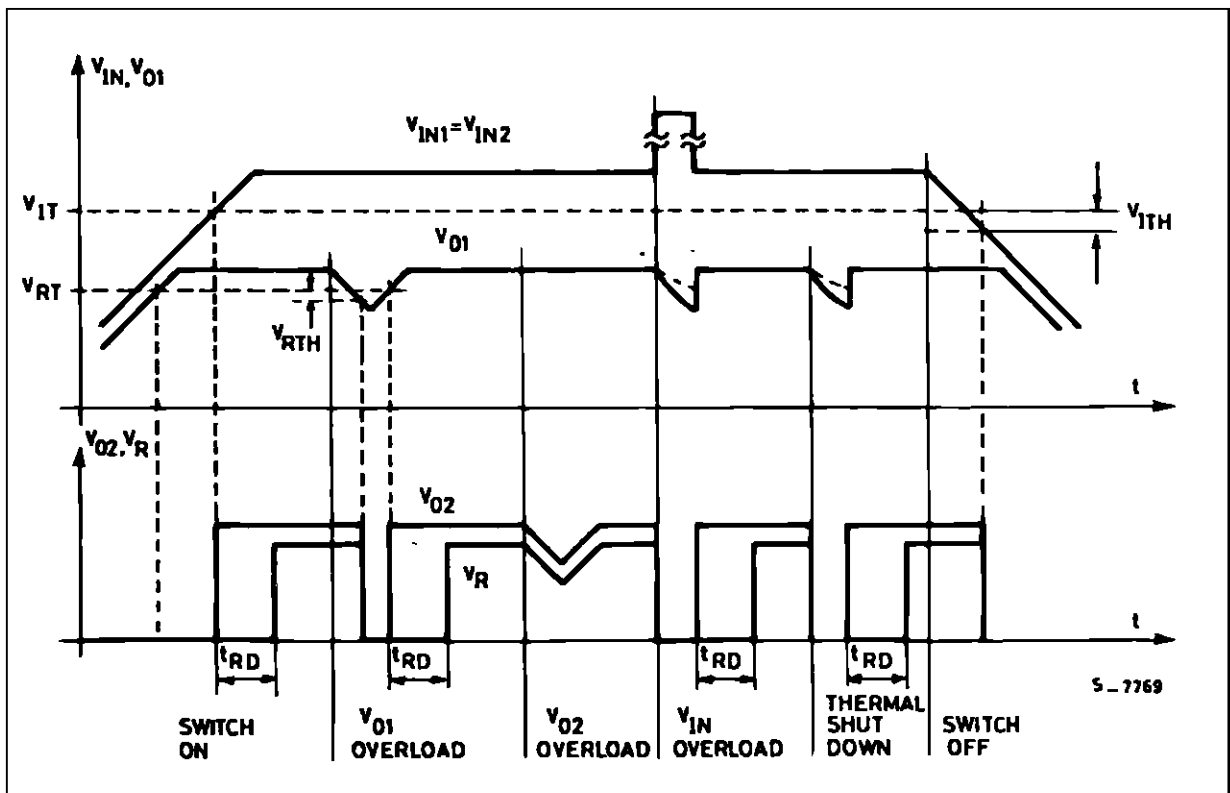


## APPLICATION NOTE

**Figure 1b** : DISABLE INPUT - The L4902 is Similar to the L4901 but also Features a Disable Input for the V2 Regulator.



**Figure 2** : WAVEFORMS - An Important Feature of the L4901 Series Regulators is that the Reset Circuit Monitors the Input Voltage.



### VERSATILE DEVICES

The L4901 and L4902 are versatile devices which simplify the supply circuitry of many systems and can be used in a number of different ways.

One possibility, outlined in figure 3, is to connect the V1 regulator permanently to a battery to supply a CMOS time-of-day clock and a CMOS microcomputer chip with volatile memory. In this example the V2 output supplies non-essential 5 V circuits. A typical use of this scheme is in trip computers or car radios with programmable tuning.

An alternative, shown in figure 4, is to use the L4901 with a backup battery on the V1 output to maintain a CMOS clock and a standby-type NMOS microcomputer chip. In this case the main on/off switch disconnects both the V1 and V2 regulators from the battery.

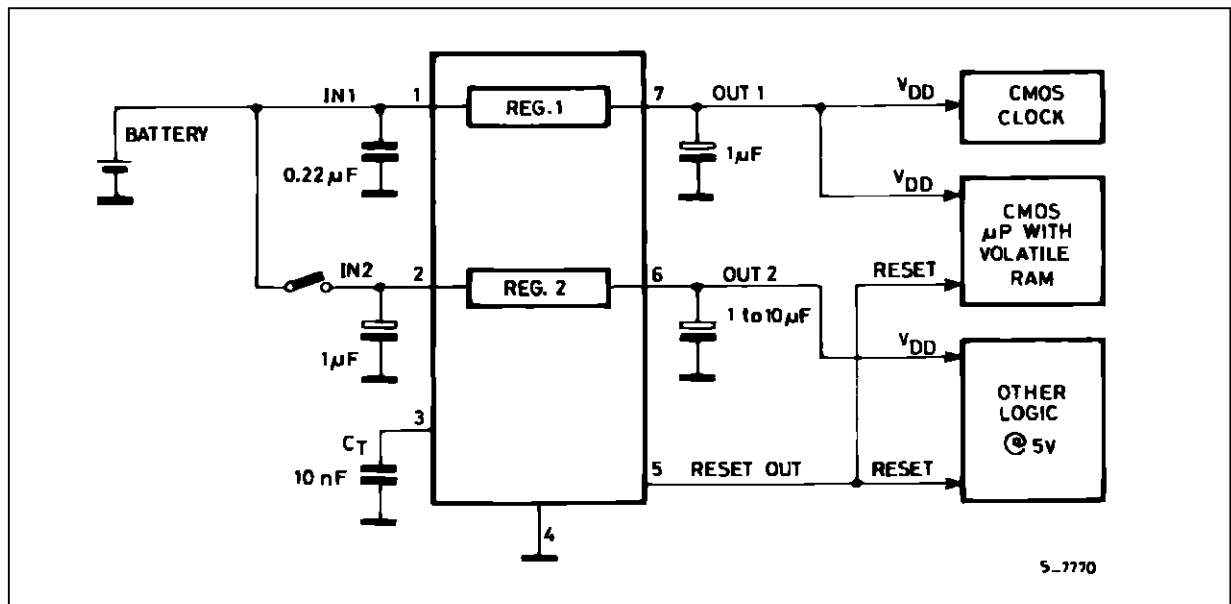
Figure 5 illustrates how the L4902's disable input may be used in a CMOS microcomputer application. In this example the V2 output, supplying non-essential circuits, is turned off under control of the micro-

processor circuit. Configurations of this type are used in products where the "OFF" switch is part of a keypad scanned by a micro which operates continuously, even in the "OFF" state.

The L4901 is also ideal for microcomputer systems using battery backup CMOS static RAMs. As shows in figure 6 the V1 output supplies the CMOS RAMs and the V2 output supplies the microprocessor plus other 5 V circuits. The L4901's reset output is used both to reset the Z80 and, through the M74HC138 address decoder, to ensure that the RAMs are disabled as soon as the main supply voltage starts to fall. Note that the M74HC138 is supplied from the backup battery.

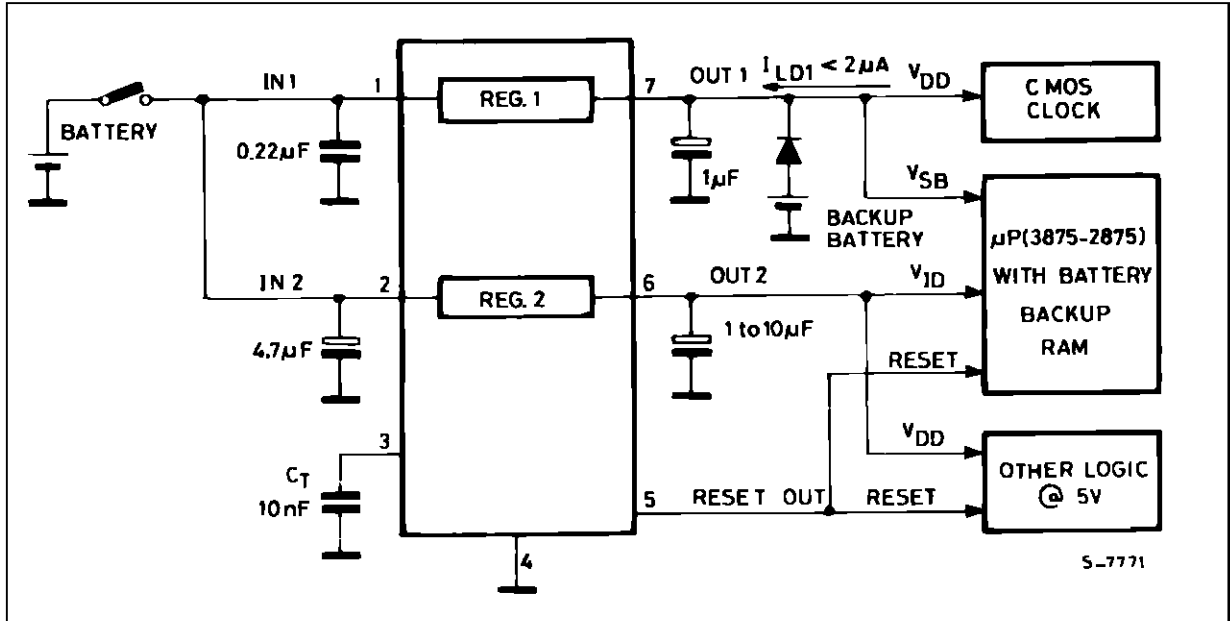
It is important to make sure that the RAMs are disabled because the lithium cells used as backup batteries have a high internal resistance. If the RAMs were not forced into the low consumption standby state the battery voltage could drop so low that memory contents are corrupted. Moreover, to prevent latch up, no input of a CMOS RAM should ever be higher than the supply voltage.

**Figure 3 :** LOW QUIESCENT CURRENT at the V1 Input makes the L4901 Useful in Applications like this where the V1 Regulator is always connected to the Battery.

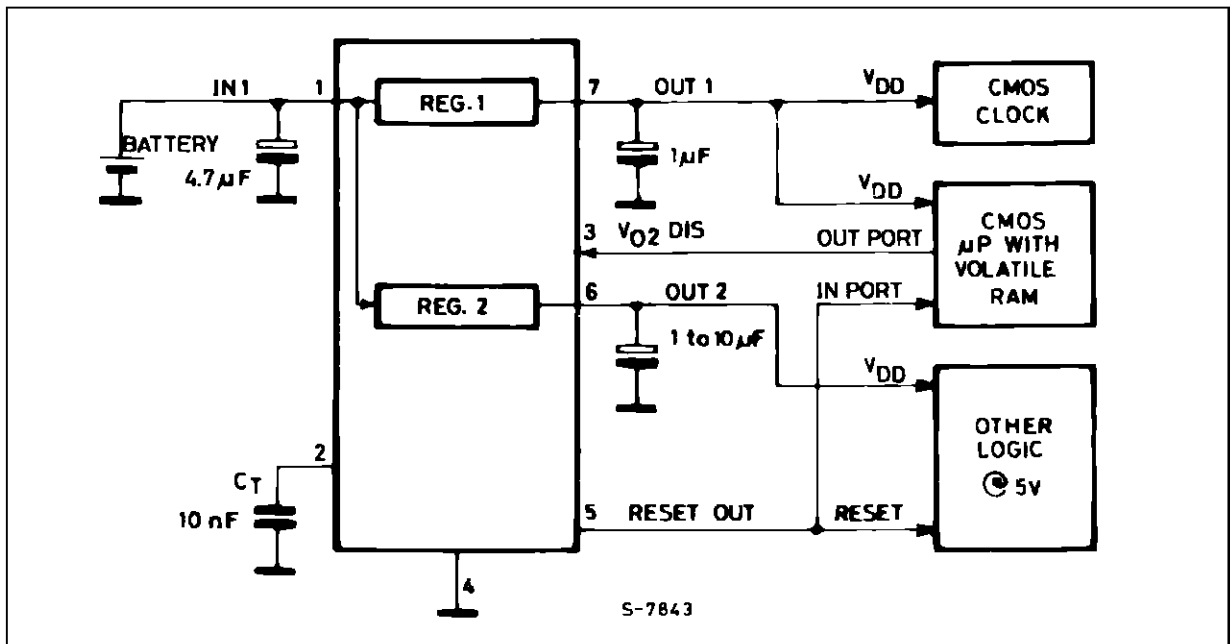


## APPLICATION NOTE

**Figure 4 :** LOW LEAKAGE at the V1 Output makes the L4901 Ideal for Battery Backup Operation.



**Figure 5 :** STANDBY - The L4902 can be used in Applications where the Supply is connected Permanently and the Disable Function Used to Turn Off on-essential Circuits in the Standby State.



### IDEAL FOR SHADOW MEMORIES

Another interesting application for the L4902 is supplying a shadow-ram microcomputer chip like the SGS-THOMSON M38SH72 where a fast non-volatile memory is backed up on-chip by a slow EEPROM (figure 7). For these chips it is important to

ensure that the backup command is generated when the supply is removed, a function which the L4902's reset output can perform. Since the L4902's reset function depends on the INPUT voltage the power fail condition is sensed early enough to guarantee that the backup transfer will be successful.

In figure 7 the reset output is forced low when the input voltage falls below 6.3 V or when the V1 output goes below 4.8 V. This allows 10  $\mu$ s for the backup transfer (with 10  $\mu$ F capacitors) which is more than sufficient.

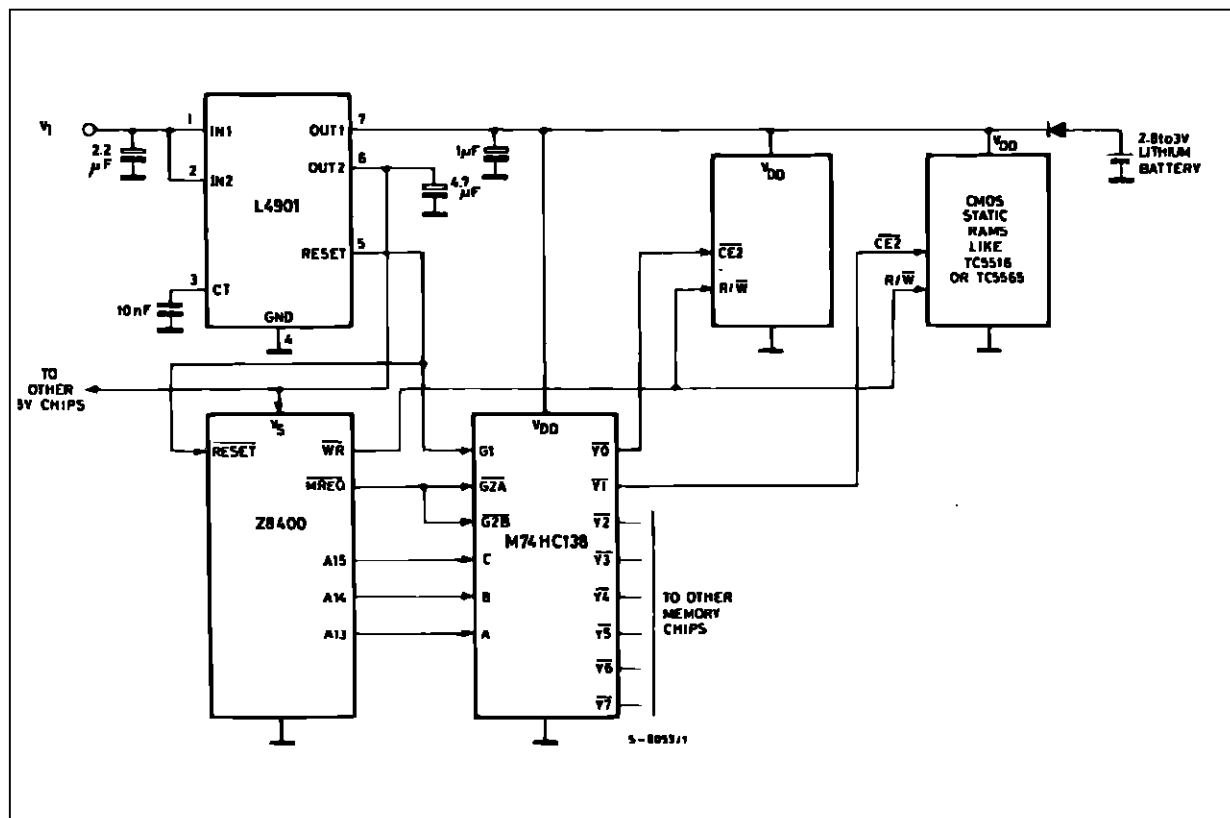
Similarly, the L4902 can be used with shadow-type RAMs such as the Xicor X2201. In the figure 8 circuit a capacitor on the V1 input ensures that the X2201 is powered during the transfer operation. When the input voltage is removed or goes below 6.3 V the L4902's reset output, connected to the 8085's TRAP input, forces the execution for a service routine which saves the state of the machine in the RAM then issues a backup command. The V2 output drops immediately while the 680  $\mu$ F capacitor on the V1 input provides enough energy to keep the X2201 running for the 10 ms needed to complete the

backup transfer. The low consumption of the V1 regulator allows the use of a relatively small capacitor for this function.

**ADDING A WATCHDOG**

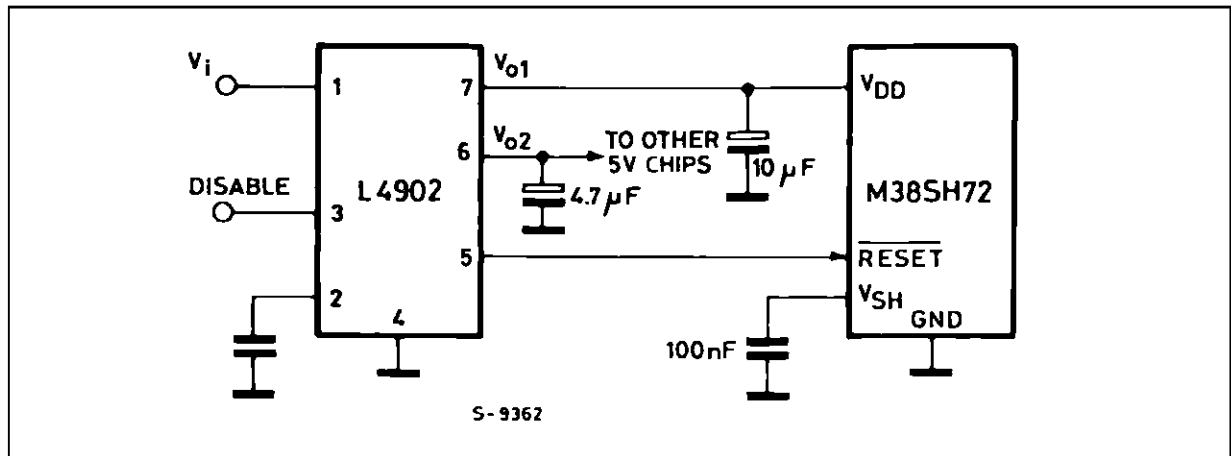
By adding a few components and two Schmitt trigger gates a watchdog function can be added to the L4902 (figure 9). Normally an output port of the micro will supply a software-generated pulse at least every 10 ms. If something has gone wrong in the software or hardware and these pulses are missing the disable input will be activated after a period set by R1.C1, disabling all the circuitry connected to the V2 output of the L4902. The disable period could be useful to prevent spurious operation of motors and solenoids while the control processor is malfunctioning.

**Figure 6 :** CMOS RAMs - The L4901 is Useful in Systems with Battery Backup CMOS RAMs Because the Reset Output can be used to Ensure that the RAM Chips are disabled to Reduce Battery Drain when the Main Supply is removed.

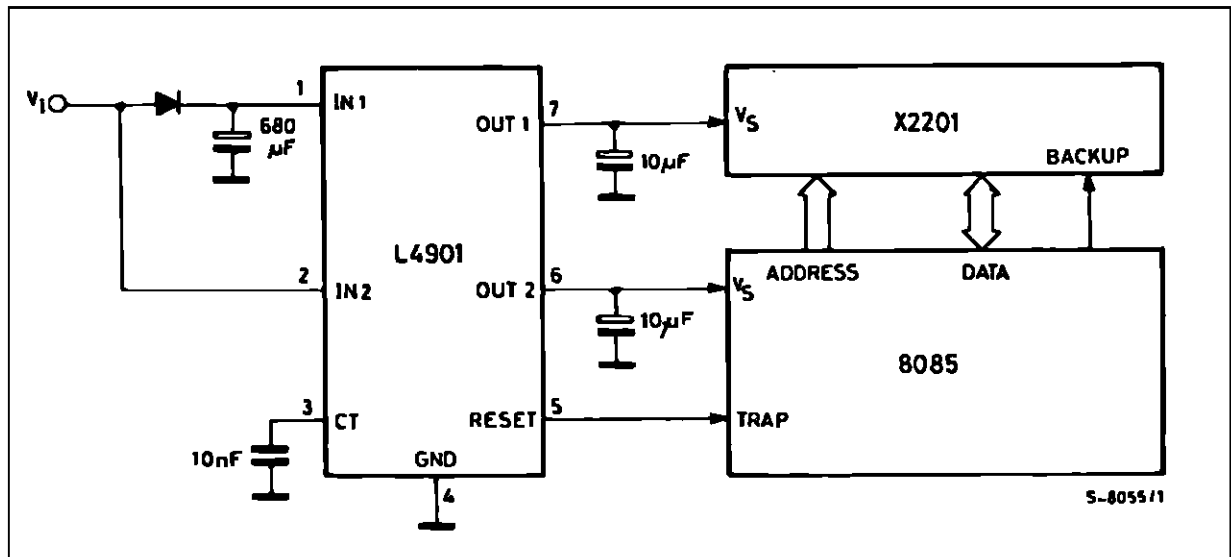


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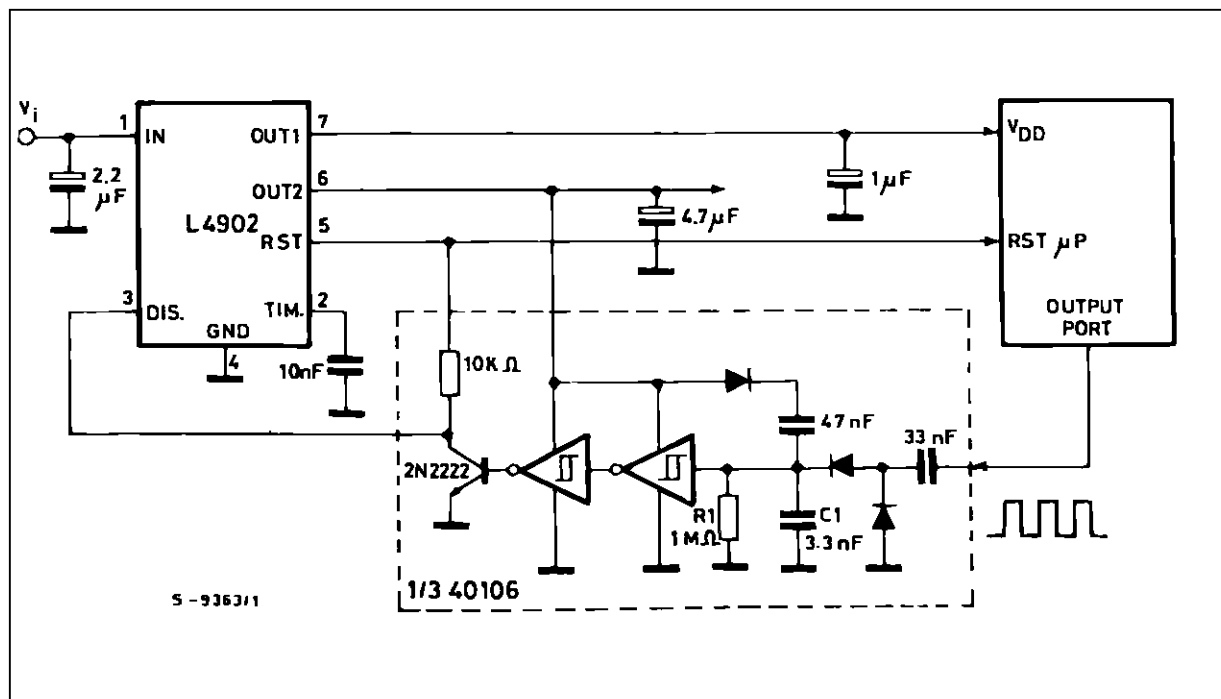
**Figure 7 :** NV MEMORY  $\mu$ Cs - The L4902 is also Useful for Supplying Chips like the SGS-THOMSON M38SH72 Single-chip Micro with NV Memory. In this Application the Reset Circuit initiates the RAM-to-shadow Transfer.



**Figure 8 :** SHADOW RAMs - The L4901's Reset Function also serves in Systems using Shadow Type NV RAMs like the X2201 to ensure that the Backup Transfer is executed Correctly.



**Figure 9 :** With a CMOS Schmitt Trigger and a few Components a Watchdog Function can be added for Critical Application.



## APPLICATION NOTE

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