CPAP

Continuous positive airway pressure (CPAP) is a type of respiratory ventilation originally developed for combating sleep apnea, which remains its primary use. It is also useful in providing ventilation for newborns and anyone suffering respiratory failure.

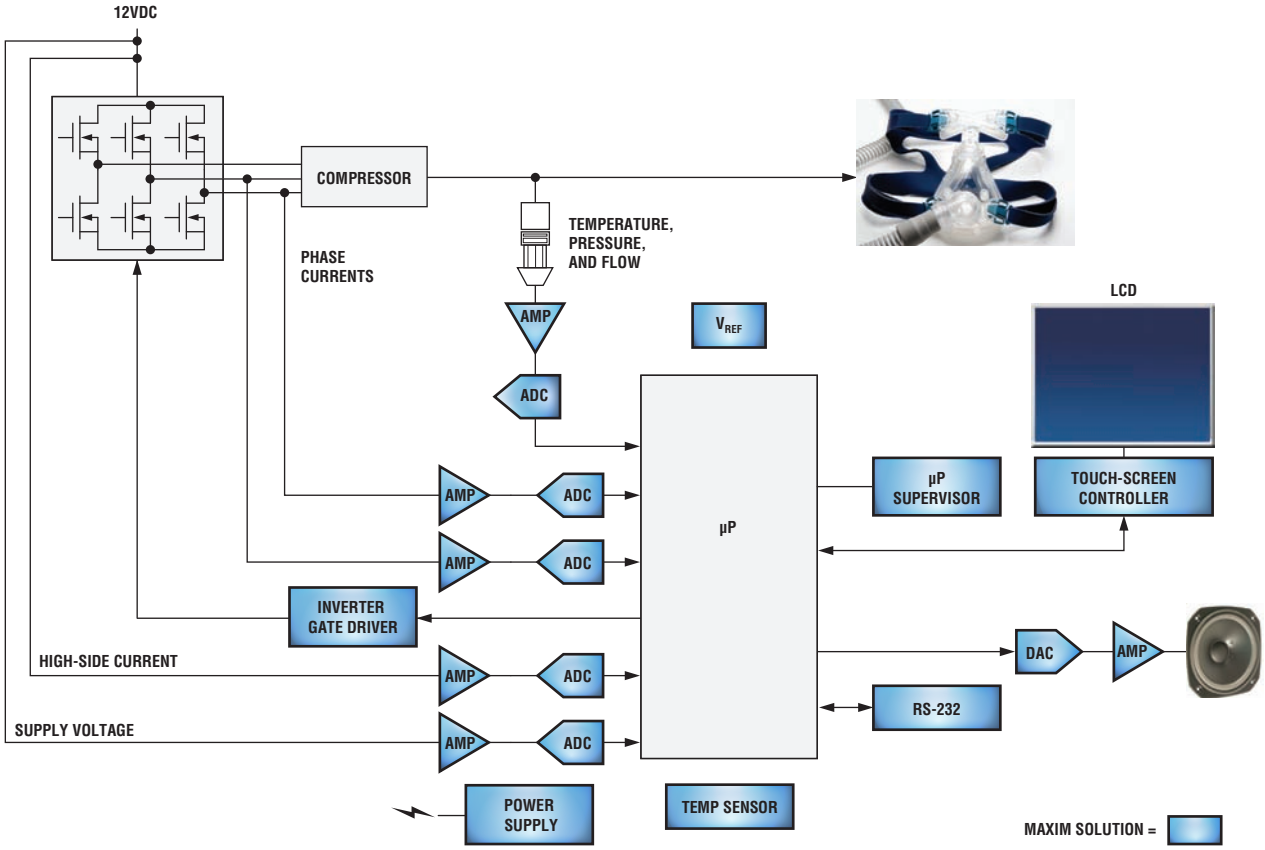
As airway muscles relax during sleep, the airway can become partially obstructed. This can lead to lower blood oxygenation and cause awakening or arousal from deep sleep. Maintaining positive air pressure by supplying a continuous source of compressed air, the face mask forms a seal to the face. It is only this air pressure that maintains the open airway, and not the actual movement of air. A sleep physician usually determines the required air

pressure after completing a sleep study.

Pressure sensors supply feedback of the applied air pressure in the mask/delivery hose to the microprocessor controller. This microprocessor controller manages the motor-drive stage of a compressor to maintain the correct fan velocity necessary to generate the required air pressure.

The main subfunctions that the system is required to monitor and control can be divided as follows:

1. **Air-hose-environment sensing** This covers air pressure, but may also include air temperature, humidity, and flow rate.
2. **Compressor motor-drive feedback** Similar to all motor-drive systems, some feedback must be provided to maintain torque and/or velocity control. Typically, phase currents or shunt current and rotor feedback must be provided.
3. **Motor-drive excitation** This is the generation of the waveforms necessary to both induce current in the electric motor and



Functional block diagram of a CPAP system. For a list of Maxim's recommended solutions for CPAP designs, please go to: www.maxim-ic.com/CPAP.

produce the torque that causes motion.

4. **Communication interface to technician/doctor** This requires the ability to display information as well as input commands and controls from the medical team. This can include LCD drivers and touch-screen controllers, as well as a means for audio communication alerts, such as beeps and tones.

Given the time and expense required to achieve FDA approval, manufacturers must select a supplier with a customer-oriented discontinuance policy to ensure that system components will be available for many years.

Medical customers rely on Maxim products because, over the years, we have carefully avoided discontinuing parts. We realize how devastating product discontinuance can be to a customer, so we work diligently to transfer some products to newer production lines, create wafer buffers, allow last-time purchases, or develop upgrade devices. Very few Maxim parts have ever been discontinued while demand still existed. Maxim's Discontinuance Policy is one of the most flexible among our peer supplier companies.

www.maxim-ic.com/CPAP

Recommended solutions

Part	Description	Features	Benefits
Op amps			
MAX9617	Ultra-low power, zero-drift, precision op amp in SC70 package	Low 59µA quiescent current; very low 10µV (max) input offset voltage; low input noise	Precise sensor interface saves power, extending battery life
MAX4238	2µV precision op amp	2µV (max) V_{OS} at +25°C; 1.5µV (max) V_{OS} drift over +100°C	Low cost and lower V_{OS} drift reduce system cost and improve performance
Current-sense amplifiers			
MAX9918	Current-sense amplifier with input common-mode range that extends well below ground (-20V)	-20V to +75V input common-mode voltage range; 400µV (max) input offset voltage; 4.5V to 5.5V single-supply operation	Extended input range reduces circuitry, thereby reducing the cost of monitoring motors and pumps
MAX9928F	Ultra-small, 6-bump UCSP™ current-sense amplifier with true, -0.1V to +28V input range	Wide -0.1V to +28V common-mode range, independent of supply voltage; -2.5V to +5.5V operating supply voltage; -20µA quiescent supply current	Space-saving, low-power motor and battery current monitor extends battery life
MAX9922	Ultra-precision, high-side current-sense amplifier	Ultra-precision V_{OS} over temperature; ±0.5% (max) full-scale gain accuracy; bidirectional or unidirectional I_{SENSE}	Ultra-precise current sensors provide more accurate battery monitoring in portable CPAPs
MAX9634	4-bump UCSP/SOT23, precision current-sense amplifier	Ultra-low 1µA (max) supply current; low 250µV (max) input offset voltage; tiny, 1mm x 1mm UCSP package	Industry's smallest, lowest power current-sense amplifier reduces solution size and standby power leakage
Touch-screen controllers			
MAX11800/801	Resistive touch-screen controllers	FIFO; spatial filtering; SPI™ interface (MAX11800); I^2C interface (MAX11801)	Dedicated screen controller reduces design cycle while offloading main processor
MAX11802	Resistive touch-screen controller with SPI interface	Single 1.7V to 3.6V supply; 25MHz SPI interface	Small footprint helps save space and reduce cost
MAX11803	Resistive touch-screen controller with I^2C interface	Single 1.7V to 3.6V supply; 400kHz I^2C interface	Small footprint helps save space and reduce cost
MAX11811	Resistive touch-screen controller with haptics driver	Integrated haptics driver; I^2C interface	Conveniently adds haptics to resistive touch-screen applications for touch feedback
RS-232 transceiver			
MAX3232E	±15kV ESD-protected, 2.5V to 5.5V, RS-232 transceiver in UCSP	Two receivers and two transmitters; 1µA shutdown mode	Internal dual charge pump and UCSP package save space
Temperature sensors			
DS600	±0.5 accurate analog-output temperature sensor	±0.5°C accuracy from -20°C to +100°C	Provides simple solution for temperature-sensing measurement
DS7505	Low-voltage, ±0.5°C accuracy digital thermometer and thermostat	±0.5°C accuracy from 0°C to +70°C; 1.7V to 3.7V operation; industry-standard pinout and registers	Industry-standard pinout allows easy accuracy upgrade from and supply-voltage reduction for LM75
DS75LV	Low-voltage, ±2.0°C accuracy digital thermometer and thermostat	±2°C accuracy from -25°C to +100°C; 1.7V to 3.7V operation; industry-standard pinout and registers	Industry-standard pinout allows easy conversion from LM75 to lower supply voltage
Supervisory IC			
MAX16056	Supervisory circuit	125nA supply current; watchdog timer	Lowest power supervisory circuit

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Recommended solutions *(continued)*

Part	Description	Features	Benefits
ADCs			
MAX1228/29	12-bit, 12-channel, 300ksps ADCs with internal reference	SAR ADC; serial interface	Integrated multiplexer saves space and simplifies design
References			
MAX6034_25	Precision, micropower, low-dropout, SC70, series voltage reference	25ppm/°C (max) tempco; 95µA (max) quiescent supply current	Increased measurement stability over temp variations; improved power savings with low I_Q
MAX6129	Ultra-low-power, series voltage reference	Ultra-low 5.25µA (max) supply current; 30ppm/°C (max) tempco	Increased power savings and improved performance stability over temp variations
Audio ICs			
MAX9860	Audio codec	Ultra-low-power, mono codec with programmable digital filter	Complete audio solution in a small, 4mm x 4mm TQFN package saves space
MAX5556	Low-cost, stereo audio DAC	No controls to set; built-in interpolation and analog output filters; I^2S-compatible, digital audio interface	Control logic and mute circuitry minimize audible pops and clicks, improving audio quality
Power ICs			
MAX15036	3A buck-boost converter	2.2MHz solution for buck or boost; wide 4.5V to 23V V_{IN} range; can drive second converter 180° out-of-phase; POR	Out-of-phase operation reduces input capacitance and, thereby, total solution size
MAX8902A	Low-noise 500mA LDO	16µV_{RMS} noise; 100mV (max) dropout at 500mA; ±1.5% accuracy over load, line, and temperature	2mm x 2mm TDFN package reduces board area requirements
MAX16814/38	4-/2-channel HB LED drivers with integrated DC-DC controller	Up to 150mA/channel; 4.75V to 40V input voltage	Eliminates need for multiple external components, thus saving space and reduces BOM cost
MAX16826	Programmable, 4-channel HB LED driver with integrated DC-DC controller	4.75V to 24V input voltage; up to 300mA/channel; I^2C interface	Easily controllable from an MCU
MAX5064	125V/2A high-speed MOSFET driver includes high and low drivers for half H-bridge	High-side driver allows 125V operation of n-channel MOSFET; 2A gate drivers; second-sourced	Enables highly efficient power conversion for cooler operation