VID Voltage Programmer for Intel Mobile Processors

by Peter Guan

Microprocessor manufacturers' relentless push for higher speed and lower power dissipation, especially in areas of mobile laptop computer processors, is forcing supply voltages to these processors to a level previously thought impossible or impractical. In fact, the supply voltage has become so critical that different microprocessors demand different yet precise supply voltage levels in order to function optimally.

To accommodate this new generation of microprocessors, LTC introduces the LTC1706-19 VID (voltage identification) voltage programmer. This device is a precision, digitally programmable resistive divider designed for use with an entire family of LTC's DC/DC converters with onboard 1.19V references. These converters include the LTC1433, LTC1434, LTC1435, LTC1435A, LTC1436, LTC1438, LTC1439, LTC1538-AUX, LTC1539 and LTC1624. (Consult the factory for future compatible DC/DC converter

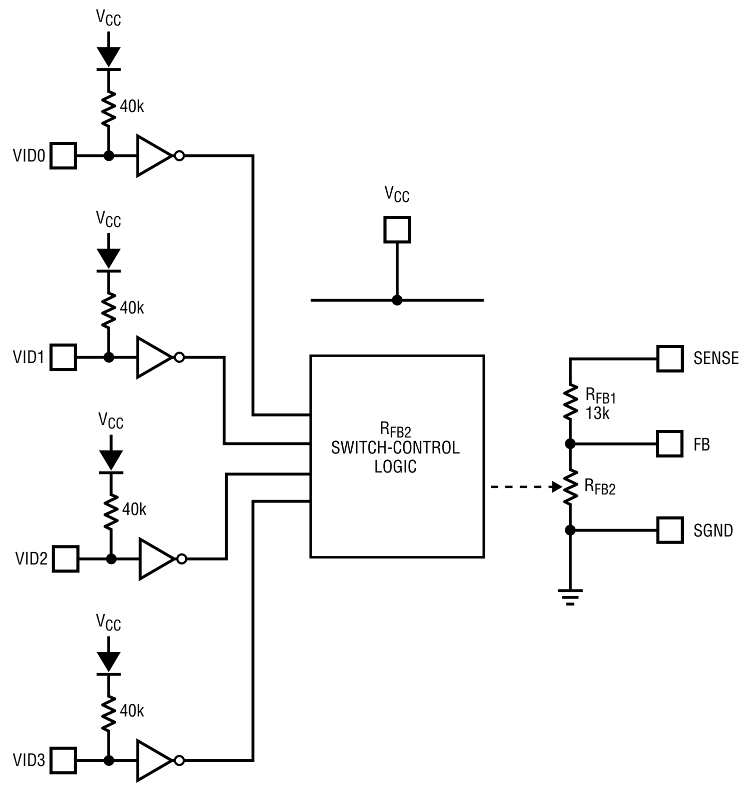

Figure 2. LTC1706-19 block diagram

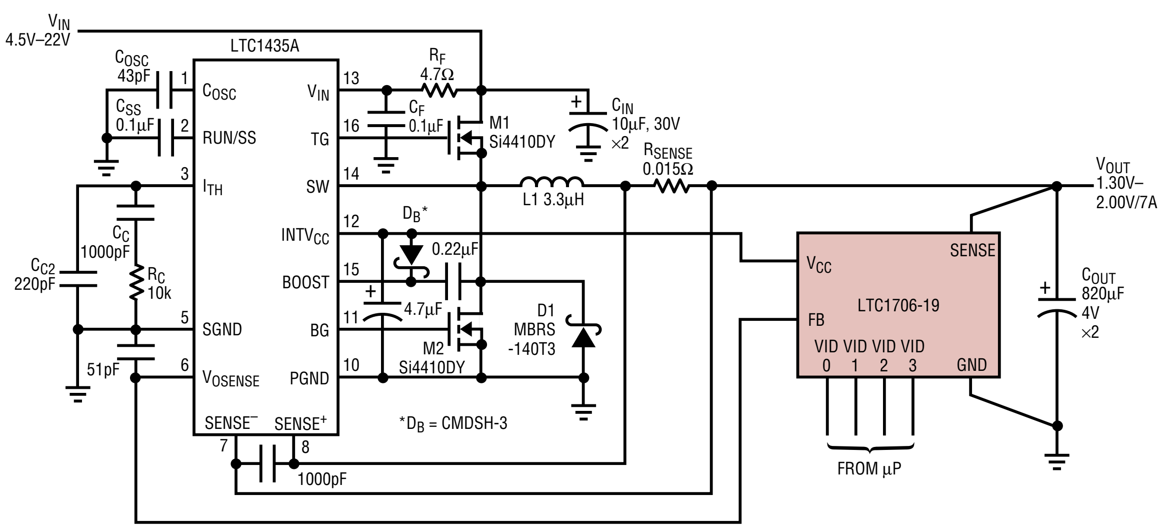

Figure 1. Intel Mobile Pentium II processor VID power converter

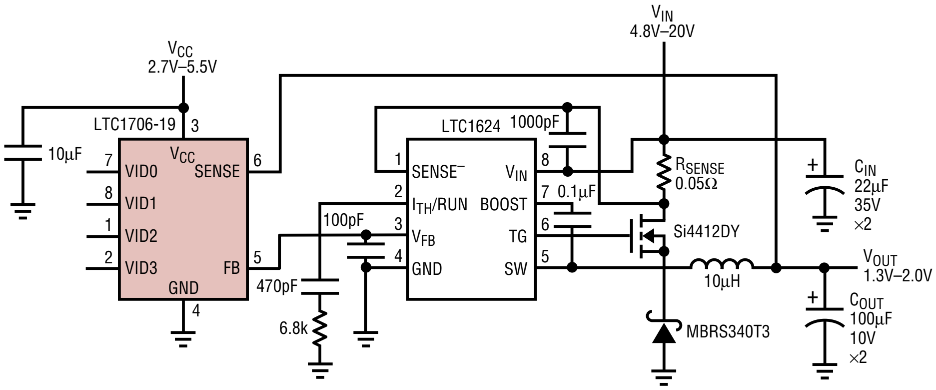

Figure 3. High efficiency SO-8, N-channel switching regulator with programmable output

products.) The LTC1706-19 is fully compliant with the Intel mobile VID specifications and comes in a tiny SO-8 package. Four digital pins are provided to program output voltages from 1.3V to 2.0V in 50mV steps with an accuracy of ±0.25%.

Figure 1 shows a VID-programmed DC/DC converter for an Intel mobile processor that uses the LTC1435A and LTC1706-19 to deliver 7A of output current with a programmable V_{OUT} of 1.3V to 2.0V from a V_{IN} of 4.5V to 22V. Simply connecting the LTC1706-19's FB and SENSE pins to the LTC1435A's V_{OSENSE} and $SENSE^-$ pins, respectively, closes the loop between the output voltage sense and the feedback inputs of the LTC1435A regulator with the appropriate resistive divider network, which is controlled by the LTC1706-19's four VID input pins.

Figure 2 shows a simplified block diagram of the LTC1706-19. A 40k resistor in series with a diode from V_{CC} pulls up each VID input pin. Therefore, the VID pin must be grounded or driven low to produce a digital low input, whereas a digital high input can be generated by either floating the VID pin or connecting it to V_{CC}. Series diodes from V_{CC} are included to prevent the inputs from being damaged or clamped by a potential higher than V_{CC}. This allows the LTC1706-19 to be fully TTL compatible and operational over a VID input voltage range that is much higher than V_{CC}. When all the inputs are high, the LTC1706-19 has a typical quiescent current of 0.1µA from V_{CC}, because all active devices are turned off. However, due to the pull-up resistors on each of the VID programming inputs, each grounded input contributes approximately 68µA, $(V_{CC} – 0.6)/40k$ of supply current in a 3.3V system.

The top feedback resistor in the block diagram, R_{FB1}, connected between SENSE and FB, is a 15k resistor whose value is not modified by the state of the VID program inputs. The bottom feedback resistor, R_{FB2}, however, is modified by the four VID inputs. The precision of the ratio between R_{FB2} and R_{FB1} results in a ±0.25% output accuracy.

Table 1 shows the VID inputs and their corresponding output voltages. VID3 is the most significant bit (MSB) and VID0 is the least significant bit (LSB). When all four inputs are low, the LTC1706-19 sets the regulator output voltage to 2.00V. Each increasing binary count is equivalent to decreasing the output voltage by 50mV. Therefore, to obtain a 1.30V output, the three MSBs are left floating while only VID0 is grounded. In cases where all four VID inputs are tied high or left floating, such as when no processor is present in the system, a regulated 1.25V output is generated at V_{SENSE}.

Figure 3 shows a combination of the LTC1624 and the LTC1706-19 configured as a high efficiency step-down switching regulator with a programmable output of 1.3V to 2.0V from an input of 4.8V to 20V. Using only one N-channel power MOSFET, the two SO-8 packaged LTC parts offer an extremely versatile, efficient, compact regulated power supply.

Table 1. VID inputs and corresponding output voltages

Code	VID3	VID2	VID1	VID0	Output
0000	GND	GND	GND	GND	2.00V
0001	GND	GND	GND	Float	1.95V
0010	GND	GND	Float	GND	1.90V
0011	GND	GND	Float	Float	1.85V
0100	GND	Float	GND	GND	1.80V
0101	GND	Float	GND	Float	1.75V
0110	GND	Float	Float	GND	1.70V
0111	GND	Float	Float	Float	1.65V
1000	Float	GND	GND	GND	1.60V
1001	Float	GND	GND	Float	1.55V
1010	Float	GND	Float	GND	1.50V
1011	Float	GND	Float	Float	1.45V
1100	Float	Float	GND	GND	1.40V
1101	Float	Float	GND	Float	1.35V
1110	Float	Float	Float	GND	1.30V

Figure 4 shows the LTC1436A-PLL and the LTC1706-19, a combination that yields a high efficiency low noise synchronous step-down switching regulator with programmable 1.3V to 2V outputs and external frequency synchronization capability.

Besides the LTC family of 1.19V-referenced DC/DC converters, the LTC1706-19 can also be used to program the output voltages of regulators with different onboard references. Figure 5 shows the LTC1706-19 programming the output of the LT1575, an UltraFast™ transient response, low dropout regulator that is ideal for today's power-hungry desktop microprocessors. However, since the LT1575 has a 1.21V reference instead of a 1.19V reference, the output will range from 1.27V to 2.03V in steps of 50.8mV.

The LTC1706-19 is the ideal companion chip to provide precise, programmable low-voltage outputs for an entire family of LTC DC/DC converters. Its compact size, compatibility and high accuracy are just the right features for today's portable electronic equipment.

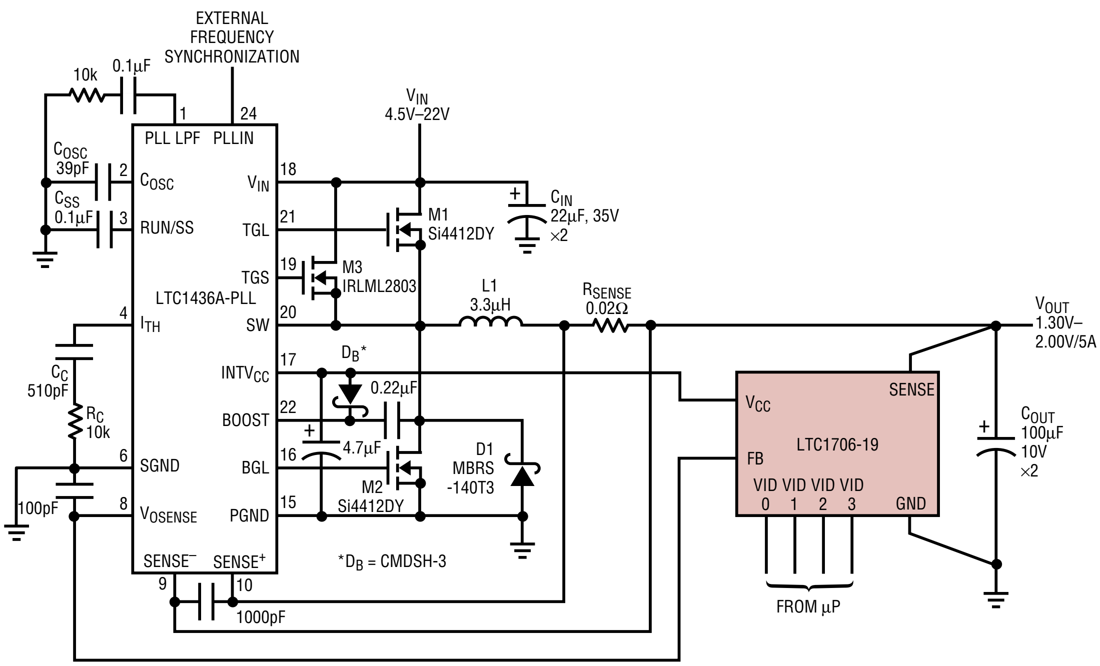

Figure 4. High efficiency, low noise, synchronous step-down switching regulator with programmable output and external synchronization

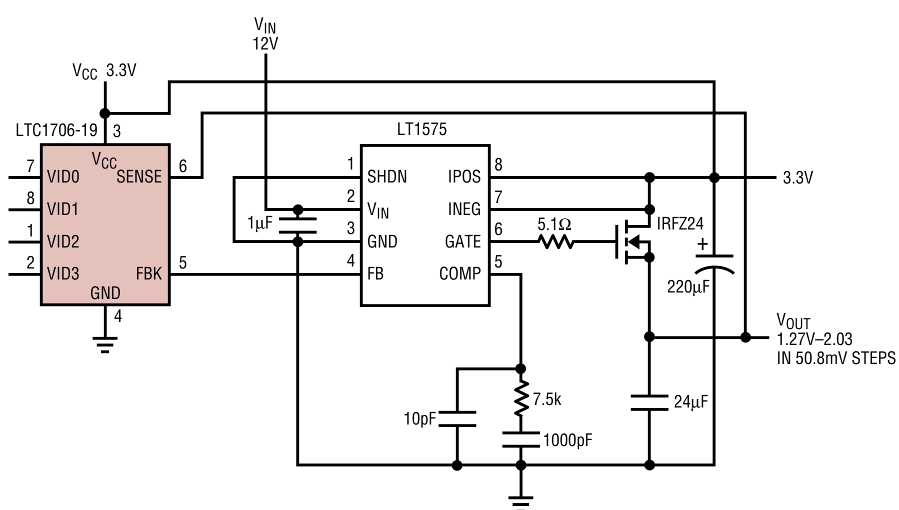

Figure 5. UltraFast transient response, low dropout regulator with adjustable output voltage