Single Switch Flyback Circuit Converts +5 VDC to +/- 12 VDC
for RS-232 and RS-422 Applications
by Bill Andreycak

Developing bipolar 12 volt supplies from a single +5 volt input can be accomplished using a number of conventional approaches. A boost converter is the most logical for the +12 volt output, however it cannot be used in some Interface circuit applications. One significant drawback of the boost topology is that even while off, the output voltage approaches the input voltage and does not go to zero. This can cause problems with many Interface line driver and receiver ICs which are functional from a five volt supply. A simple Flyback converter is a better choice for these applications which will allow the output voltage to go to zero when the control IC is turned off.

The negative supply also can be generated from the same Flyback transformer used for plus twelve volt output if an additional winding is provided. The result is a three winding transformer, and often cross regulation problems between the outputs. One way to avoid this is by incorporating two separate, but identical transformers, one per output. Each of these requires only two windings (primary and secondary) and may be a lower cost solution to a single three winding Flyback transformer. In many applications, even Local Area Networking (LAN) data line isolation transformers, or common mode EMI chokes can be used. The Appendix section of this Design Note lists several potential vendors, products and phone numbers. In many Interface circuit power supply applications the load currents drawn from the bipolar supplies are fairly similar. When this applies, the positive output voltage will vary proportionately with the negative supply. To simplify voltage regulation, the positive

Figure 1. +5 to ±12V/80mA Converter
voltage alone can be measured and used for feedback to the PWM control IC. The negative output voltage will track along reasonably well, and is adequate for many applications. This adaptation significantly reduces the complexity of regulating both outputs simultaneously, which would otherwise require two separate converters and control ICs.

The circuit shown in Figure 1. develops a plus and minus 12 volt output at 80 milliamps each from a +5V input supply. Excellent regulation is obtained with identical loading on both outputs, and degrades only slightly with differential loading. A small amount of preloading can be added to improve cross-regulation for more demanding conditions. Note that both transformer primaries are electrically in a parallel configuration, and energy is stored and released from both simultaneously. This is advantageous during differential loading, as energy stored in one core can be delivered to the other transformer's secondary. The result is a significant improvement in overall and cross regulation if they have low leakage inductances. Magnetic modelling [1,2] can be used to further gain familiarity with this application.

REFERENCES

APPENDIX - List of some Transformer Manufacturers and Products
COILCRAFT : DLF, LAX, P104, TTDLF, TRF, and WB Series’, phone # 1-800-322-2645 (U.S.A.)
COILTRONIX : CTX series of two winding coupled inductors, also the VERSAPACK series of multiple winding transformers is applicable, phone # 1-561-241-7876 (U.S.A.)
IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE (“CRITICAL APPLICATIONS”). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER’S RISK.

In order to minimize risks associated with the customer’s applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI’s publication of information regarding any third party’s products or services does not constitute TI’s approval, warranty or endorsement thereof.

Copyright © 1999, Texas Instruments Incorporated