Subject: **5V Auxiliary “Keep Alive” Circuit**
Applies to: STM17, STM23, STM24, ST5/10, SV7
Streaming SCL commands or Q programs only
Date: July, 2012
Author: Glenn Johnson, Applications Engineer

Description
This document addresses an application where a dedicated secondary power supply is used to maintain logic power to a motor drive while the primary power supply is turned off or disconnected. This is often referred to as a “Keep Alive” circuit.

Keep Alive Capability
Many machines incorporate a killswitch/e-stop that an operator can use to cut power to potentially hazardous parts of the machine. Often this includes motors and their drive electronics. While cutting power to a drive will indeed render it safe, it also makes fault recovery difficult because state data (motor position, etc) is lost in the event of a power cycle. The drive is unable to continue its previous operation without a homing routine, which may lead to loss of product if the machine was interrupted during a critical process. For various reasons such a product loss is often unacceptable.

The solution is to cut main drive power while maintaining a very low power auxiliary supply for logic power only. Such a supply will, by design, be insufficient to engage the drive’s power stage and cause motion of any kind, but it will allow the drive to maintain its internal position counter, monitor I/O, communicate with an external controller, etc. Recovery from the fault condition is a simple process and will allow the machine to pick up with minimal disturbance to the process.

Keep Alive Supply
The DC supply chosen must satisfy the following requirements:

Voltage: 5VDC +/-5%

Current: 250mA per drive for drives without Ethernet or encoder interfaces
500mA per drive for drives with Ethernet or encoder interfaces
750mA per drive for drives with Ethernet and encoder interfaces

Sharing a Supply
It is possible to share a single supply across multiple drives, but there are a few key points that must be observed.

First, a blocking diode must be used on each drive. It is important to understand that the 5V and GND terminals on each drive actually form a local 5V supply intended for use with the drive’s own analog input. When the 5V lines of multiple drives are connected, there is a tendency for one or more drives to attempt to power the others, a condition that can lead to various alarms and generally unreliable behavior.

A blocking diode installed at the 5V terminal will allow current to flow into the drive while preventing that drive from attempting to power other devices.

Diodes should be chosen for their current rating (250mA or 500mA minimum, depending on drive type), favoring those with low forward voltage drops. Schottky diodes such as the SB220 from Vishay Electronics is a good choice. Note that the specific diode chosen is not as critical as the fact that all diodes used be of the same type. Do not mix diode types on the keep alive bus.

Second, the 5V bus itself must be as efficient as possible. Large conductors should be used for the main bus trunk. The drives' connectors require smaller conductors, so each branch should be kept as short as possible to minimize Ohmic losses due to bus construction.

Finally, the DC supply itself must be adjusted to compensate for the forward voltage drop of the diode chosen as well as the empirically measured voltage drop of the bus itself. Consider a bus with long cable runs and small conductors that causes a 1V drop, coupled with standard diodes with a 0.7V forward voltage drop. The 5V keep alive supply would actually need to be adjusted to 5 + 0.7 + 1 = 6.7VDC to compensate for the losses and generate a clean 5V at each drive.

Wiring details for a test network is shown on page 5.

Power Up Sequence
One important procedure must be observed to ensure proper operation of the drive and motor. During the machine's initial power up sequence, it is critical that the main DC bus power (24-80VDC, drive-dependent) be supplied to the drive first, *with at least a 5 second delay before* the 5V auxiliary supply is powered.

During initialization, the drive performs a probe of the motor, briefly energizing it to measure critical motor parameters and perform an alignment of the motor's rotor to its encoder (if used). If the 5V supply is brought up before the main DC power is supplied, the drive's logic will engage but will have insufficient power to move the motor, and the motor probe operation will yield unreliable data. Even after main DC power is applied and the drive gains control of the motor, the bad motor data gleaned during the initial probe operation can adversely affect motor operation and reliability.

If the main DC bus is powered first, the drive can initialize itself normally. The 5V supply causes no disturbance when applied, allowing the drive to properly control its motor.

This sequence is only critical during machine power up. Once initialized, the killswitch/e-stop function can cut power to the main DC bus without issue.

Keep Alive Circuit in Operation
When main input power is removed from the drive, the supply voltage drops as expected. An undervoltage alarm is generated, the appropriate LED sequence is displayed, and the Alarm Output is activated (if configured). Most importantly, the encoder is still monitored so any movement of the motor will be tracked.

When main power is restored, the bus voltage will rise back to normal levels. This can be monitored by an external controller via the SCL command Immediate Voltage (IU) or directly within a Q program by monitoring the read-only register “u”. Once the main bus voltage is within acceptable limits, the alarm must be cleared. This is accomplished via SCL with the Alarm Reset (AR) command. The motor must also be re-enabled, which can be accomplished with the Motor Enable (ME) command. Note that the encoder position is retained, and may be queried either by the Encoder Position (EP) command or by reading the contents of the ‘e’ register.

In this manner it is possible to resume operation from the motor’s last position rather than re-homing the system, possibly causing loss of time and product.

Keep Alive Recovery with Streaming (SCL) Commands:

1. Main power is removed, logic remains powered and an undervoltage alarm is generated. This alarm will display as a flashing LED pattern and a bit in the alarm code, which can be read by the host using the AL command.
2. Monitor the primary power supply voltage using the IU command. The IU command reads in units of 0.1V. For example, at 24.1 volts the response to the IU command will be IU=241. Consult the Hardware Manual for your drive for acceptable operational voltage limits.
3. After the primary power supply has been restored, the fault must be cleared. To clear the fault, send the AR command. The alarm word will become 0. The motor will remain disabled.
4. Send the ME command to enable the motor.
5. As the motor may have moved while main power was lost, the EP command may be used to verify the motor’s current position.
6. Resume motion and normal program operation.

Keep Alive Within a Q Program:

1. Enable fault handling by including the OF command in your Q program.
2. Main power is removed, logic remains powered and an undervoltage alarm is generated. This alarm will display as a flashing LED pattern and a bit in the alarm code, which can be read by the host using the AL command.
3. When a fault condition occurs, this will immediately cause the program to jump to the Q segment specified by the command’s parameter. Any segment from 1-12 may be used as a fault handler / recovery routine.

4. In this fault handling segment, the program should monitor the read-only register “u”. This is analogous to sending the SCL command “IU”. Consult the Hardware Manual for your drive for acceptable operational voltage limits.
5. After the primary power supply has been restored, the fault must be cleared. To clear the fault, use the AX command. The alarm word will become 0. The motor will remain disabled.
6. Use the ME command to enable the motor.
7. As the motor may have moved while main power was lost, the “e” register may be checked to verify the motor’s current position.
8. Use a QX command to exit the fault handling routing and return to an appropriate Q segment to resume machine operation.

Sample Wiring Diagram

The example diagram below shows the necessary keep alive connections for DC powered drives. Consult your drive’s Hardware Manual for specific wiring considerations.