Purpose:

To describe a way application programmers can prevent uncontrolled motor runaways due to external encoder bearing or coupling failures. This problem only affects customers who purchased motors with external encoders from ORMEC or customers using motors with encoder feedback acquired from other sources. Customers known to have purchased motors affected by this bulletin from ORMEC have been notified directly.

Encoder bearing or coupling failures can cause a significant safety hazard including the chance of personal injury and damage to the machine. We strongly recommend that customers implement the recommended modifications and/or protect machine operators from runaways by other means.

Description:

This problem can affect any motor which derives both position and velocity feedback from a separate encoder mounted on the back of the motor, or mounted separate from the motor, instead of using the transducer built into the motor. If the external encoder bearing or coupling fails and the encoder stops rotating, both the position and velocity loops will be open and the motor will runaway at full torque. If the failure occurs while the axis is being commanded to move, the failure will be detected in the time it takes the commanded position to move the distance set by the axis maximum position error setting (PERR.MAX@).

If the failure occurs while the axis is enabled but not being commanded to move, the actual position data does not change (due to the failed encoder). Since neither the commanded position or the reported position is changing, the axis will not be able to detect the increasing position error and has no way to detect the runaway. Depending on the servo drive, the runaway may continue indefinitely or until the servo drive detects an overspeed fault using the built in transducer.
This does not affect any standard catalog motor supplied by ORMEC unless it has been modified by others to use an external encoder for both position and velocity feedback. (See "Protection From Other Failures").

**ORMEC Part Numbers Affected:**

The following part numbers supplied by ORMEC are affected. Motors acquired from other sources, or modified by others to have externally mounted encoders, may also be affected.

<table>
<thead>
<tr>
<th>Motor Model</th>
<th>Drive Model</th>
<th>RPM per Volt</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC-J47001</td>
<td>SAC-J47001</td>
<td>194</td>
</tr>
<tr>
<td>MAC-J51001</td>
<td>SAC-J51001</td>
<td>188</td>
</tr>
<tr>
<td>MAC-J516003</td>
<td>SAC-J516003</td>
<td>394</td>
</tr>
<tr>
<td>MAC-J631601</td>
<td>SAC-J631601</td>
<td>194</td>
</tr>
<tr>
<td>MAC-J639501</td>
<td>SAC-J51603</td>
<td>394</td>
</tr>
<tr>
<td>MAC-J652201</td>
<td>SAC-J652201</td>
<td>381</td>
</tr>
<tr>
<td>MAC-J666301</td>
<td>SAC-J652201</td>
<td>381</td>
</tr>
</tbody>
</table>

**Solution:**

The following solution assumes that you are using an ORMEC standard catalog servo drive or the non-catalog drive supplied by ORMEC as listed in the above table. The solution may not work with other servo drives.

The axis should be reconfigured to obtain velocity feedback from the analog velocity signal generated by the drive rather than the external encoder. To do this the DSP axis card must be equipped with the /A analog input option.

The effect of this change is that should the encoder fail, velocity feedback will be maintained. If an encoder failure occurs while the axis is being commanded to move, the axis will stop as soon as the position error reaches the value of PERR.MAX@. If an encoder failure occurs while the axis is not being commanded to move, the axis will creep at a low speed indefinitely rather than runaway at a high speed.

To implement the change, add the following immediately after the MP.CONFIG statement in your program:

```
KVHA@(axis)=value
KVH@(axis)=0
KPI@(axis)=0
CW.FWD@(axis)=FALSE
```

Where:
- **axis** is the axis I.D. for the axis with the external encoder.
- **value** is equal to the RPM per volt for the drive used on the affected axis. This value is shown in the table of part numbers affected.
ORMEC's cables CBL-J523301 and CBL-J47002 include a connection which takes the drive velocity output to the axis card analog input AIN2. If you have different cables or did not purchase the cables from ORMEC, you may need to add this connection.

This modification will only work if your system is set so forward (positive) motion corresponds to counter-clockwise motor rotation (CW.FWD@=FALSE). If your application requires CW.FWD@ to be set TRUE, you will need to modify your program to invert the sign of all position related commands and variables associated with the affected axis.

It is very important that PERR.MAX@ for the axis be set for the minimum possible non-zero value.

**Protection From Other Failures**

It is important to note that this problem will not occur with ORMEC's standard catalog motors.

All ORMEC standard catalog motors have transducers mounted directly to the motor shaft so there is no coupling or bearing to fail. In addition, the feedback encoder (or resolver) is also used for drive commutation. If it were to fail in an undetectable way, the drive would not be able to commutate the motor and a runaway can not occur.

To protect against electrical failures, circuitry built into ORMEC's DSP axis cards is constantly checking the electrical integrity of the encoder signals (both internal and external) and will disable the axis should any anomaly occur.

**Additional Information**

Contact ORMEC Service Department for any questions or assistance in making this modification.