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To: MPC79.distribution  
From: The MPC79 Organizers  
Subject: **MPC79 Informational Message #4**  
Filed on [MAXC]Conway>MPC79.memo4

This is MPC79 informational message #4, which describes some of the conventions in use for interpreting CIF files. The principal reason for this message is to define the MPC79 interpretation of those aspects of CIF that are influenced by implementation considerations and which typically vary from installation to installation as a function of the plotting and patterning devices to be used.

As was mentioned in Message #1, full CIF 2.0 (as documented in Chapter 4 of "Introduction to VLSI Systems" by Mead and Conway) is being supported by MPC79. Many of the subtle CIF implementation considerations are discussed in Chapter 7 of the upcoming Second Edition of "A Guide to LSI Implementation" by Hon and Sequin (an advance copy of this chapter has been sent to all project coordinators). An overview of some of the more relevant issues is given in this message.

A further motivation for this message is that we can provide better support if certain restrictions are observed. Furthermore, certain constructs take much more processing time than others and we would like you to be aware of these considerations.

## 1. CIF CONSTRUCTS

This section presents our interpretation of certain CIF constructs.

**Box:** Straightforward interpretation.

**Roundflash:** Approximated by an octagon that is always aligned with the overall chip axes.

**Wire:** For wire segments involving turn angles up to and including 90 degrees the interpretation used is exactly that suggested in Ch. 7 of the Implementation Guide. For sharper angles, no "extension" of the segments is used, but a Roundflash is output at the corner. The ends of wires are always squared off. This interpretation does lead to a sudden change in the shape of a corner as the corner angle passes through 90 degrees, but it was chosen to allow efficient processing of the common case of wires consisting of segments aligned with coordinate axes.

**Polygon:** All variants of polygons are supported, including non-convex and those with a self intersecting boundary. A point is considered to be inside the polygon if the winding number of the boundary with respect to that point is non-zero. That is, for a point to be considered inside the polygon, a line joining the point to a point moving along the boundary must make a non-zero net number of complete rotations around the given point as the boundary point makes one traversal of the boundary. This interpretation was motivated by the desire for the same results when a self intersecting wire is represented as a CIF wire or as a CIF polygon describing the boundary of the wire. This interpretation is described more fully in Ch. 7 of the Implementation Guide.

User Extension Command: All user extension commands are treated as comments, except that a warning is given.

Layer Names: The following six mask layer names will be recognized and will lead to the inclusion of the affected geometric items into the indicated MEBES mask layer file:

ND Diffusion  
 NP Polysilicon  
 NC Contact cut  
 NM Metal  
 NI depletion mode Implant  
 NG overGlass opening

Anything defined on a layer of any other name is treated as unknown, is ignored, and a warning is given. For example, layer NB (Buried contact) is treated as unknown since buried contacts are not supported by MPC79. Layer NX (which is used once in the library sent out) is also in this category.

In general we do not request that the fabrication facility overglass wafers containing multiproject chips. However, overglass masks will be produced for MPC79, and it's possible that some fraction of the MPC79 wafers will be overglassed. Therefore, any bonding or contact pads should have appropriate cuts specified in the overglass layer of the project's CIF file. The Pads in the MPC79 library have such cuts specified, so it will be necessary to specify overglass cuts only if you use some other bonding pads or if you intend to use probe pads.

Delete Definitions (DD): Interpreted as in Ch. 7 of the Implementation Guide. Note that we do not require any DD commands between project files, since in the MPC79 effort we are requiring that projects be self-contained (see also item 3.), so that we can independently process and merge projects into the starting frames.

Warning messages: Our CIF parser produces warning messages on detecting certain questionable constructs (such as zero-width wires, among other things). These may or may not result in the design being NACKed, depending on whether it appears that the error is in fact fatal or not. However, even if the design is ACKed by us, any warning messages should be examined carefully to see if they indicate some serious error.

## 2. CONSEQUENCES

Roundflash and Wire: In view of the variation in interpretation from installation to installation of the circular arcs found in ideal wires and flashes, it is advisable to adopt a conservative approach to the use of wires. Two extreme approximations to the ideal shapes can be considered - inscribing and circumscribing. If you wish to ensure contact between a wire or flash and some other object in your design (independent of the implementation system to be used) then you should make certain that a system using an inscribing approximation would still place these objects in contact. To ensure adequate separation between a wire or flash and some other object (independent of the implementation system to be used) make certain that a system using a circumscribing approximation would still position these objects with sufficient separation. Whenever the need arises for more precise control over the geometry than can be realized by the above approach then do not use wires, or flashes, but use boxes or polygons instead.

The interpretation of Roundflash and Wire commands in MPC79 gives a circumscribing approximation. Consequently there should never be any problem with relying on one of these constructs touching another if that is what is desired. However, design rules may be encroached

upon in some cases where use of the ideal shapes would cause no problems. In particular, consider the corners of the squared off ends of wires, and 90 degree bends.

**Polygons:** The interpretation of polygons differs from the convention sometimes used in computer graphics of considering that a point is inside a polygon if a line drawn from the point to infinity in any direction intersects the boundary an odd number of times. The interpretation used here is believed to be more relevant to the needs of mask layout. If you are using a different convention, and you have polygons with self-intersecting boundaries, then it will be necessary for you to make adjustments.

### 3. IMPLEMENTATION ISSUES

**CIF Libraries:** Each CIF file must provide a complete specification of the design, including copies of any library symbols used. Do NOT assume that we will prefix each project with a copy of the library sent to you. For each project it will be necessary for you to extract, from the libraries provided to you, copies of the symbols used by that project, and to include them in the CIF file for the project.

**The impact of your choice of a CIF subset:** Various subsets of the full CIF 2.0 may be worth considering for a variety of reasons. It should be remembered that the MPC79 system is experimental, and involves the use of much new and unproven software. Consequently you may hurt yourself, and others, if you set out to push all the facilities to the limits in an attempt to thwart the system. Furthermore, the amount of processing involved in MPC79 will require many hours of computing time here at PARC. Features such as arbitrarily rotated symbols, and contorted wires and polygons can greatly expand the processing time required. Indeed, extreme examples of enormous fully instantiated files that make grossly inefficient use of CIF may find themselves NACKed. You would therefore be doing us (and probably yourselves) a favor if you keep it simple wherever possible.

**ICARUS:** At several schools the Alto-based system ICARUS is available. A subset of CIF can be converted to and from ICARUS format for viewing or modifying on an Alto. If this is likely to be of interest then the CIF file should contain only Boxes that have rotations of integer multiples of 90 degrees, and Wires having segments aligned with the coordinate axes. Symbol rotations must be constrained to integer multiples of 90 degrees also.

**Check Plots:** While we are not routinely providing a plotting service, we will be making use of check plots to check on certain designs. Errors found while examining these plots will be reported to you if we believe they represent errors on your part. Consequently, it may be in your interest to make plotting easier for us. At the time of writing this message we have two methods for obtaining check plots, (1) by converting to ICARUS and using its facilities for Versatec and color plots, and (2) by direct plotting of the individual layers on the Versatec only. The first of these gives nice plots but imposes the constraints on CIF cited above. The second is driven off our MEBES conversion software and as such implements everything, however the plots are of single layers only. While we hope to achieve the best of both these worlds in time for use during the later stages of merging MPC79, we cannot be sure of this.

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