

HAL COMMUNICATIONS CORP.
ENGINEERING DRAWING NUMBER STANDARDS
November 21, 1990
Revised December 12, 1990

The following drawing numbering system is used for all drawings and documents at HAL Communications Corp. This system has been in continuous use by HAL Communications since July, 1973.

1. SCHEMATIC, MECHANICAL, MISCELLANEOUS, and CIRCUIT BOARDS

Drawing numbers include 6 characters constructed as 1 Letter - 4 Numbers - and 1 Letter. For example:

A 1786 B = Schematic Diagram of A1786 Power Trans.

Revision (no letter = base original)

4-digit Sequential Number

Drawing Type:

A = Schematic Drawings

B = Mechanical Drawings

C = Miscellaneous Drawings

D = Circuit Board Layouts

1.1 Number Assignment:

Drawing numbers are assigned sequentially as drawn. When possible, related drawings for a given product or assembly are assigned sequential numbers, but this has not been required nor systematically enforced. In some cases, the drawing number relates directly to the HAL part number of a physical part.

1.2 Revision Level:

The final character in the drawing number is the revision level. When first drawn, the drawing has no revision letter -- "baseline originals". The first revision that results in a production change or a drawing release to outside concerns is assigned revision letter "A". Further revisions are assigned "B", "C", "D", etc. As per DOD-STD-100C, the letters "I", "O", "Q", "S", "X", or "Z" are not to be used as revision letters.

NOTE: HAL inclusion of the revision level within the part number does not conform to DOD-STD-100C which requires a separate title block entry for the revision letter. Therefore, the HAL title block will be revised to include a "REV" title block and the revision letter entered. However, HAL shall continue its revision link to the part number for the sake of continuity.

1.3 "A" Drawings - Schematic Diagrams:

All schematic drawings have an "A" letter prefix. One product, assembly, or sub-assembly may have several pages of schematic drawings. Each schematic drawing is assigned a separate and unique "Axxxxr" drawing number. With rare exceptions, schematic drawings are made on "B" sized paper (11 x 17 inches). Contents of each drawing are adjusted to show related circuits on the same drawing whenever possible. Total symbols and text on each drawing is controlled to minimize clutter and assure readability. The readability guideline is that, when the drawing is reduced to "thesis margins" (7.5" x 9.5"), all text, lines, and symbols are easily read. The final criteria is the readability of reproduced drawings when published in 8.5" x 11" manuals ("A" size).

In the special case of transformers manufactured to HAL Communications Corp. specifications, the "A" schematic drawing number is used when constructing the HAL inventory part number. For example:

P/N 800-17500 = DWG A1750 = LP1210 Power Transformer
P/N 800-17860 = DWG A1786 = ST-8000A Power Transformer

The final digit of the part number indicates the revision level of the drawing:

0 = baseline drawing
1 = Revision "A"
2 = Revision "B"
etc.

1.4 "B" Drawings - Mechanical Fabricated Parts

All custom-manufactured mechanical parts are shown in drawings with a "B" prefix. These drawings are drawn full-scale whenever possible. The "B" size (11x17) is the minimum drawing size used for Mechanical drawings; "D" size (22 x 34) is the maximum size of mechanical drawings. It is HAL policy that only one mechanical piece is specified on a given "B" drawing; one drawing does not specify multiple pieces.

Mechanical part numbers and HAL mechanical drawing numbers are directly related. For example:

P/N 000-14110 = DWG B1411 = ARQ-1000A Top Cover (orig. ver)
P/N 000-14412 = DWG B1441B = LP1210 Top/Bottom Cover, Rev B

The final digit of the mechanical part number reflects the drawing revision level as in the case for schematic diagrams.

Some parts such as transformers have both a schematic and a mechanical drawing. In the case of transformers, the "A" drawing number (schematic) sets the HAL part number. In the case of custom key-switches, the "B" drawing number sets the HAL part number. 1.5 "C" Drawings - Miscellaneous Drawings

"C" drawings include most engineering drawings that do not easily fit into the "A", "B", or "D" categories. Included in the "C" drawing classification are:

- Block Diagrams
- Circuit Board Parts Placement Pictorial Diagrams
- Cabinet Assembly Pictorial Diagrams
- Software Flow-Charts
- Special Figures for Manual Illustrations
- Building Floor Plans
- Organizational Charts
- Art-work for Panel Silk Screen Label

Some custom parts, such as front and rear panels and key-switch assemblies may have "A" (schematic), "B" (mechanical), and "C" (key-switch lettering) drawings describing the same part.

A "C" drawing number is not used when building the HAL Part Number.

1.6 "D" Drawings - Circuit Boards

All circuit board layout art-work has a "D" prefix drawing number. The "D" drawing number directly relates to the HAL part number as follows:

P/N 050-12320 = D1232 = LP1210 Extender Circuit Board

P/N 050-12333 = D1233C = PCI-3000 Circuit Board, Rev. "C"

As noted above, the final digit of the part number reflects the drawing revision level.

"D" Drawing numbers for printed circuit boards actually represent a set of drawings or negatives. All printed circuit (PWB) layout is done using Computer Aided Design (CAD). Individual trace drawings and related art-work are inseparably linked within the CAD system. Therefore, one "DxxxxR" drawing number is specified for a complete set of physical drawings. For example a 4-layer circuit board may have the following separate entities:

- Layer One Traces (top, component side)
- Layer Two Traces (internal, adjacent to top)
- Layer Three Traces (internal, adjacent to bottom)
- Layer Four Traces (bottom, solder side)
- Solder Mask (same for top and bottom)
- Silk Screen Printed Labels (top only)
- Mechanical Outline (usually included with drill chart)
- Drill Chart (usually included with outline)

The circuit board industry convention is that all layers are "right-reading" as viewed from the top (component side).

CHANGE FROM 11/21/90 VERSION: Board layers are now specified with layer one at the top. This is the reverse of previous standards used by HAL and our PCB suppliers, but now conforms to current industry standards.

Printed circuit board procedure at HAL Communications Corp. has been to generate 2x sized digital plots of each layer and have full-sized photo negatives created (1/2 of digital plot size). The plots (and CAD computer files) are then archived at HAL and the negatives provided to the circuit board manufacturer.

At this writing, HAL is in the process of converting to "Gerber-format" and "N/C-compatible" output computer files. When completed, only the digital files on computer diskette need be produced and provided to the circuit board manufacturer. This procedure will not result in

generation of 2x digital plots which may then be archived.

To provide hard-copy examples of the printed circuit art-work for Configuration Control and for Quality Assurance / Inspection use, special 1x sized digital plots will be prepared of each "layer" of each circuit board produced. These 1x "Master Copies" and a digital storage version of the CAD file (diskette or tape) will be provided to Configuration Management.

2.0 SOURCE and SPECIFICATION CONTROL DRAWINGS

All parts used by HAL Communications Corp. are detailed on "Parts Specification Forms", one form for each unique part procured. These "Parts Specification Forms" are being converted to SOURCE CONTROL DRAWINGS or SPECIFICATION CONTROL DRAWINGS, using DOD-STD-100C as a guideline. The procedure is as follows:

1. The SCD (Source or Specification) Number shall be the HAL Part Number in the format "xxx-yyyy", where "xxx" specifies the part group classification, and "yyyy" specifies the part itself.
2. A SOURCE CONTROL DRAWING shall be used to specify all standard commercially-manufactured parts.
3. A SPECIFICATION CONTROL DRAWING shall be used to specify all custom manufactured parts, designed by HAL Communications. Relevant schematic ("A"), mechanical ("B"), miscellaneous ("C"), and circuit board ("D") drawings shall be referenced on the SPECIFICATION CONTROL DRAWING. A copy of the "A", "B", or "C" referenced drawings shall be attached to all copies of the SCD. SCD's for printed circuit boards will reference the appropriate "D" drawings but printed copies of trace artwork will be supplied only on an "as required" basis. The "Master Copy" shall reside with Configuration Control.
4. All purchase orders for HAL parts will reference the appropriate SCD and include a copy of the referenced drawing with each Purchase Order when required by contract.

3.0 ALTERED ITEM DRAWINGS (New Section 12/12/90)

ALTERED ITEM DRAWINGS are much like Source and Specification Control Drawings and use a similar "A" sized drawing title block. Altered Item Drawings are used to specify any changes that HAL has to make in a purchased item before it may be used in a HAL product.

The primary HAL use of Altered Item Drawings will be to specify programmed EPROM parts. Unprogrammed EPROM parts will have a "670-xxxxx" part number, while programmed EPROMs

will have a "675-yyyyy" part number ("yyyyy" related to product and revision level). The Altered Item Drawing will specify the base part (27C256 for example) and the software code loaded in the EPROM (ST8000 U12, V1.4, for example).

4.0 PARTS LISTS

For the purpose of Configuration Management (and compatibility with DOD-STD-100C), all Parts Lists shall be considered to be "drawings".

1. The Parts List drawing number shall be of the format "PLxxx-yyyyy" where "PL" stands for "Parts List" and "xxx-yyyyy" is the standard standard HAL part number for the assembly, sub-assembly, or product listed. For example, the drawing number for the parts list for the ST-8000 Front Panel Assembly shall be "PL920-08000".
2. Parts Lists shall be prepared on "A" size title block (8.5 x 11) paper with continuation sheets as required.
3. Parts Lists shall be included in the HAL Configuration Management Program. The master copy of all current parts lists shall reside in the Configuration Master Library.

5.0 COMPUTER SOFTWARE DRAWINGS

For the purpose of Configuration Management, all computer software programs, listings, and specifications shall be considered drawings and issued unique drawing numbers for archive by Configuration Management. Computer software shall be archived in both printed and digital forms (printed listings and ROM, PROM, diskette, or tape media).

All computer "drawings" shall use be assigned a standard HAL part number in the range of 880-xxxxx through 899-xxxxx. The "group code" (880 - 899) shall specify the type of computer "drawing"; different part numbers shall be assigned to each media form of software storage (paper listing, computer file, ROM, EPROM, magnetic tape, etc.).