

Drawing Note Generator

Karen McConnell CID, Harry Finocchiaro, and Scott Park
Lockheed Martin – EPICenter
Cherry Hill, NJ

Abstract

This paper will describe the method used to automate drawing note creation at Lockheed Martin. It will discuss the reasons for the automation and some of the decisions that needed to be made before automation could take place. This paper will compare common methods of creating drawing notes and document the reasoning for writing the Note Generator. The Lockheed Martin Note Generator will be demonstrated as part of the presentation.

Common Drawing Notes

Lockheed Martin developed a common set of notes to be used across the corporation for rigid and rigid/flex notes. The specification was created to allow for the variety of products. A program was created to assist with the implementation of the standard notes. The program makes it easy for the designer to generate “fresh” notes for each board. The real time generation of notes forces the designer to verify that all requirements were flowed down.

Lists 1 and 2 below show a subset of the Lockheed Martin notes used for this paper and presentation.

It is important to work with your fabricators when developing your notes. The notes should not target one fabricator but be usable by all fabricators. It is a good idea to ask for a review by all targeted fabrication houses. Incorporate the enhancements, changes and corrections from the fabricator before programming the generator.

List 1: Lockheed Martin Rigid Printed Wiring Board Notes

Color Codes:

Red indicates variable values to be filled in

Blue indicates optional wording – generally indicates additional requirements that may be added depending on design and intended use.

Green indicates references to help determine proper note selection. Do not include in actual drawing note.

Variables and info herein are LMC recommendations and are not intended to be all-inclusive.

NOTES: UNLESS OTHERWISE SPECIFIED:

1. INTERPRET THIS DRAWING IN ACCORDANCE WITH (IAW) THE FOLLOWING STANDARDS/SPECIFICATIONS:

A. IPC-2221 AND IPC-2222 TYPE **3**, CLASS **3**, LEVEL **B**. (DESIGN)

B. See the variables defined below in Note 2A.

C. Any others as required

The callout of IPC-2222 by default includes IPC-D-325 (for drawing requirements), ANSI/ASME Y14.5M, 1994 (for dimensioning), ANSI/IPC-T-50 (for terms and definitions).

2. QUALIFICATION AND PERFORMANCE REQUIREMENTS:

A. IPC-6011 AND IPC-6012 TYPE **3**, CLASS **3**, PLATING PROCESS **1**, FINAL FINISH **T**.

If you leave off 6012 Class, Plating Process and Final Finish refer to IPC-6012 for defaults.

OR

LOCKHEED MARTIN 00000000 (CAGE CODE: #####)

OR

LM##### (Site specific document for fabrication.)

AND

- THE PRINTED WIRING BOARD SHALL MEET THE REQUIREMENTS OF THE REVISION IN EFFECT AT THE TIME OF PROCUREMENT

Available IPC Note Variables:

Class 1 – General Electronic Products (May be used for EDU builds)

Class 2 – Dedicated Service Electronic Products

Class 3 – High Reliability Electronic Products

2221 Types

- Type 1 – Single Sided Board*
- Type 2 – Double Sided Board*
- Type 3 – Multilayer Board without blind or buried vias.*
- Type 4 – Multilayer Board with blind and/or buried vias.*

Levels

- Level A – General Design Complexity – Preferred*
- Level B – Moderate Design Complexity – Standard*
- Level C – High Design Complexity – Reduced Producibility*

Plating Processes

- 1 (Acid copper electroplating only)*
- 3 (Acid and/or pyrophosphate copper electroplating)*

Final Finish

- S (Solder Coating)*
- T (Electrodeposited Tin-Lead, (fused))*
- X (Either Type S or T)*
- SMOBC (Solder Mask over Bare Copper)*
- IT (immersion tin) is starting to become popular in BGA*
- ENIG (Electroless nickel, immersion gold) is starting to become popular in BGA*

Available IPC Note Variables:

- Class 1 – General Electronic Products (May be used for EDU builds)*
- Class 2 – Dedicated Service Electronic Products*
- Class 3 – High Reliability Electronic Products*

2221 Types

- Type 1 – Single Sided Board*
- Type 2 – Double Sided Board*
- Type 3 – Multilayer Board without blind or buried vias.*
- Type 4 – Multilayer Board with blind and/or buried vias.*

Levels

- Level A – General Design Complexity – Preferred*
- Level B – Moderate Design Complexity – Standard*
- Level C – High Design Complexity – Reduced Producibility*

Plating Processes

- 1 (Acid copper electroplating only)*
- 3 (Acid and/or pyrophosphate copper electroplating)*

Final Finish

- S (Solder Coating)*
- T (Electrodeposited Tin-Lead, (fused))*
- X (Either Type S or T)*
- SMOBC (Solder Mask over Bare Copper)*
- IT (immersion tin) is starting to become popular in BGA*
- ENIG (Electroless nickel, immersion gold) is starting to become popular in BGA*

B. NO IPC-6012 SPECIAL REQUIREMENTS TESTING REQUIRED.

OR

THE FOLLOWING IPC-6012 TESTING REQUIREMENTS APPLY

The following testing can drive cost and lead-time.

(if any are required, see table and call out requirement by title, not paragraph number)

Special Requirements Testing Table

- 3.11.1 Outgassing*
- 3.11.2 Organic Contamination*
- 3.11.3 Fungus Resistance*
- 3.11.4 Vibration*
- 3.11.5 Mechanical Shock*
- 3.11.6 Impedance Testing*

If Impedance testing is required, add the following:

IMPEDANCE REQUIREMENTS SHALL BE VERIFIED BY TIME DELAY REFLECTOMETRY (TDR) TEST ON MANUFACTURER SUPPLIED COUPON (SEE NOTE 11 FOR IMPEDANCE REQUIREMENTS).

- 3.11.7 Coefficient of Thermal Expansion (CTE)*
- 3.11.8 Thermal Shock*
- 3.11.9 Surface Insulation Resistance*

C. SUPPLIED TEST COUPON IS IAW IPC-2221

Use this note if you are supplying coupons.

If not, use:

THIS DESIGN DOES NOT INCLUDE QUALITY CONFORMANCE COUPONS. MANUFACTURER SHALL INCORPORATE REPRESENTATIVE COUPONS IAW IPC-2221 AND/OR USE PRODUCTION BOARDS FOR QUALITY CONFORMANCE INSPECTIONS

3. **MATERIAL REQUIREMENTS:**

MANUFACTURER SHALL SELECT MATERIALS TO ACHIEVE A BALANCED CONSTRUCTION AND TO MEET THE REQUIREMENTS SPECIFIED HEREIN, INCLUDING DIMENSIONAL REQUIREMENTS IN STACKUP VIEW (or table).

If the stackup does not fully dimension the dielectric configuration and the design supports uniform dielectric thickness throughout, then the following note should be added:

THE SPACING BETWEEN EACH CONDUCTOR LAYER SHALL BE EVENLY DISTRIBUTED THROUGH THE TOTAL FINISHED THICKNESS, WITH EACH INDIVIDUAL DIELECTRIC SPACING BEING WITHIN 25% OF THE AVERAGE DIELECTRIC SPACING OF THE BOARD.

A. LAMINATE AND PREPREG MATERIALS PER IPC-4101/XX (Optionally add TYPE ____, i.e. GFN, GIN, etc.).

Old Mil S-13949 Equiv.	IPC-4101 Slash Sheet	Tg Glass Transition	Resin System	Reinforcement
13949/4 GF, GFN, GFK	4101 / 21	110°C	Epoxy, Flame Resistant	Woven "E" Glass fabric
13949/4 GF, GFG	4101/24	150 - 200°C	Majority Epoxy Modified or Unmodified Flame Resistant	Woven "E" Glass fabric
13949/10 GI, GIN	4101/40	200°C minimum	Polyimide	Woven "E" Glass fabric
13949/10 GI, GIL	4101/41	250°C minimum	Polyimide	Woven "E" Glass fabric
13949/10 GI, GIJ	4101/42	200°C-250°C	Polyimide	Woven "E" Glass fabric
13949/31 BI	4101/53	220°C minimum	Polyimide	Non-Woven Aramid
13949/22 BF	4101/55	135°C – 190°C	Modified Epoxy	Non-Woven Aramid
13949/27	4101/70	230° minimum	Cyanate Ester	Woven "S-2" Glass fabric
13949/29 GC	4101/71	230° minimum	Cyanate Ester	Woven "E" Glass fabric

B. COPPER FOIL SHALL BE IN ACCORDANCE WITH IPC-4562/ X, QUALITY CLASSIFICATION 3

Where X is the specification sheet number (See 1.2.1 of IPC-4562). IPC-MF-150 has been superseded by IPC-4562. Material properties and values have been updated (typically increased) in 4562 to reflect current industry values. The below table provides a cross-reference between the 150 and 4562.

For multi-layer boards, copper weight should be designated in the cross-sectional "stack-up" view of the drawing or a separate table.

IPC-MF-150 SLASH NO.	IPC-4562 SLASH NO.	FOIL GRADE	FOIL DESCRIPTION
IPC-MF-150/1	IPC-4562/1	CU-E1	(STD-Type E) Standard electrodeposited
IPC-MF-150/2	IPC-4562/2	CU-E2	(HD-Type E) High ductility electrodeposited
IPC-MF-150/3	IPC-4562/3	CU-E3	(HTE-Type E) High temperature elongation electrodeposited
IPC-MF-150/4	IPC-4562/4	CU-E4	(ANN-Type E) Annealed electrodeposited
IPC-MF-150/5	IPC-4562/5	CU-W5	(AR-Type W) As rolled-wrought

IPC-MF-150/6	IPC-4562/6	CU-W6	(LCR-Type W) Light cold rolled-wrought
IPC-MF-150/7	IPC-4562/7	CU-W7	(ANN-Type W) Annealed-wrought
IPC-MF-150/8	IPC-4562/8	CU-W8	(LTA-Type W) As rolled-wrought low temp. annealable
IPC-MF-150/9	IPC-4562/9	NI/E1	Nickel, standard electrodeposited
N/A	IPC-4562/10	CU-E10	(LTA-Type E) Electrodeposited low temperature annealable
N/A	IPC-4562/11	CU-E11	(A-Type E) Electrodeposited annealable

IPC-4562 Quality Classifications

- Class 1 – Material in this class is suitable for applications where mechanical properties and cosmetic defects are not important, and the only requirement is functionality of the complete circuit. This material has no prescribed inspection and testing requirements.
- Class 2 – Material in this class is suitable for use where circuit design, process yield, and specification conformance requirements allow localized areas of non-conformance. This material has moderate levels of assurance, demonstrated via the use of testing and/or statistical process control (SPC)/statistical quality control (SQC) techniques.
- Class 3 – Material in this class is suitable for applications where high levels of assurance are required. These levels of assurance shall be demonstrated via the use of testing and/or SPC/SQC techniques.

- C. THE MINIMUM NUMBER OF REINFORCING LAYERS BETWEEN ADJACENT CONDUCTIVE LAYERS SHALL BE TWO.
- D. THE MINIMUM DIELECTRIC SPACING SHALL BE **0.0035** INCH (**90** MICROMETERS).

4. CONDUCTOR SPACING:

CONDUCTOR SPACING ON FINISHED PRODUCT SHALL BE NO LESS THAN:

0.XXX INCH (**0.XXX** MM). – INTERNAL

0.XXX INCH (**0.XXX** MM). – EXTERNAL

FOR REFERENCE ONLY: ELECTRONIC DATA MINIMUM SPACING IS **0.XXX** INCH (**0.XXX** MM)

5. CONDUCTOR WIDTH:

THE FINISHED CONDUCTOR WIDTH SHALL BE THE NOMINAL ARTWORK DIMENSION +/-:

0.XXX INCH (**0.XXX** MM) – INTERNAL

0.XXX INCH (**0.XXX** MM) - EXTERNAL

FOR REFERENCE ONLY: ELECTRONIC DATA MINIMUM CONDUCTOR WIDTH IS **0.XXX** INCH (**0.XXX** MM).

CONDUCTOR WIDTH TOLERANCE DOES NOT APPLY TO CONTROLLED IMPEDANCE TRACES. SEE NOTE 11.

Conductor width tolerances from IPC-2221 Table 10-3

This table is based on 1 oz. Copper. Thicker copper may require adjustment.

Feature	Level A	Level B	Level C
Without plating	± 0.06 mm (± 0.0024 in)	± 0.04 mm (± 0.0016 in)	± 0.015mm (± 0.0006 in)
With plating	± 0.10 mm (± 0.004 in)	± 0.08 mm (± 0.003 in)	± 0.05 mm (± 0.002 in)

6. MAXIMUM RATED VOLTAGE:

THE MAXIMUM RATED VOLTAGE IS **XXX** VOLTS

In extreme cases the following words may be used:

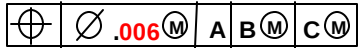
THE MAXIMUM RATED VOLTAGE IS **XXX** VOLTS EXCEPT BETWEEN POINT **A** AND **B** THE MAXIMUM RATED VOLTAGE SHALL BE **YYY** VOLTS.

7. DIMENSIONAL REQUIREMENTS:

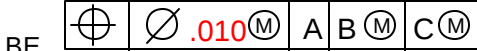
A. DIMENSIONAL LIMITS APPLY AFTER PLATING.

B. HOLE LOCATIONS ARE DEFINED BY THE X-Y COORDINATES IN THE SUPPLIED ELECTRONIC DATA BASED ON THE ESTABLISHED DATUMS.

- C. UNLESS OTHERWISE SPECIFIED, ALL PLATED THROUGH HOLES SHALL BE



- D. UNLESS OTHERWISE SPECIFIED, UNSUPPORTED HOLES SHALL



- E. .0018 INCH (.046 MM) DIAMETER AND SMALLER HOLES MAY BE FILLED WITH SOLDER.

8. PLATING AND FINAL FINISH REQUIREMENTS:

Plating Options (reminder, these are exceptions to the plating requirements in Note 2A):

If you say nothing, you'll get solder coating or electrodeposited fused tin-lead IAW IPC-6012

- A. PLATING NOTE 9A PLATING NOTE VARIABLE ADDITIONAL NOTE TEXT.
- B. PLATING NOTE 9B

9. SOLDERMASK/COATING REQUIREMENTS:

- A. SOLDERMASK NOTE 9A SOLDER NOTE VARIABLE ADDITIONAL NOTE TEXT.
- B. SOLDERMASK NOTE 9B

10. MARKING:

- A. MARK THE FOLLOWING INFORMATION AS APPLICABLE, ON LAYER 1 OF TEST COUPON AND LAYER XX SIDE OF THE PRINTED WIRING BOARD PER MIL-STD-130, .0XX INCH HIGH CHARACTERS, USING A NON-CONDUCTIVE, EPOXY BASE INK CONTRASTING IN COLOR. [PART NUMBER, REVISION], MFR-CAGE CODE, [SERIAL NUMBER] AND DATE CODE
Typical minimum character height should not be less than 0.060 inch (1.5 MM) (from IPC-2221).
If location is critical, the detail drawing should show approximate location and refer to this note.
OR
- A. MARK IAW IPC-6012 INCLUDING DATE CODE IN THE FORMAT YYWW WHERE YY IS THE LAST 2 DIGITS OF THE YEAR AND WW IS THE CALENDAR WEEK.
IPC-6012 requires traceability, manufacturer's trademark or logo and date code (optional).
If you include part ID number and revision or pattern letter in your artwork, this note best leverages IPC-6012 and is the simplest form.
If location is critical, the detail drawing should show approximate location and refer to this note.
- B. MARK LAYER XX USING SILKSCREEN LAYER XX AND LAYER YY USING SILKSCREEN LAYER YY USING A NON-CONDUCTIVE, EPOXY BASE INK, CONTRASTING IN COLOR.
- C. SPECIAL NOTE 10C.

11. IMPEDANCE REQUIREMENTS:

Impedance requirement note text is shown as IMPEDANCE NOTE TEXT.

12. OTHER/OPTIONAL NOTES:

Optional note text is not shown except as RIGID OPTIONAL NOTE 1, RIGID OPTIONAL NOTE 2, and RIGID OPTIONAL NOTE 3.

List 2 Lockheed Martin Rigid/Rigid Flex Printed Wiring Board Notes Color Codes:

Red indicates variable values to be filled in.

Blue indicates optional wording.

Green indicates references to help determine proper note selection. Do not include in actual drawing note. Variables and info herein are LMC recommendations and are not intended to be all-inclusive.

NOTES: UNLESS OTHERWISE SPECIFIED:

- 1. INTERPRET THIS DRAWING IN ACCORDANCE WITH (IAW) THE FOLLOWING STANDARDS/SPECIFICATIONS:
 - A. IPC-2221 AND IPC-2223 TYPE 3, USE A, CLASS 3, LEVEL B. (DESIGN)
See the variables defined below in Note 2A.
 - B. Any others as required

2. QUALIFICATION AND PERFORMANCE REQUIREMENTS:

- A. IPC-6011 CLASS **3**, IPC-6012 PLATING PROCESS **1**, FINAL FINISH **T**, AND IPC-6013 TYPE **3**, USE **A**.

- THE PRINTED WIRING BOARD SHALL MEET THE REQUIREMENTS OF THE REVISION IN EFFECT AT THE TIME OF PROCUREMENT.

Available IPC Note Variables:

Class 1 – General Electronic Products (May be used for EDU builds)

Class 2 – Dedicated Service Electronic Products

Class 3 – High Reliability Electronic Products

2221 Types

Type 1 – Single Sided Board

Type 2 – Double Sided Board

Type 3 – Multilayer Board without blind or buried vias

Type 4 – Multilayer Board with blind and/or buried vias

Levels

Level A – General Design Complexity – Preferred

Level B – Moderate Design Complexity – Standard

Level C – High Design Complexity – Reduced Producibility

6013 Types

Type 1 Single-sided flexible printed wiring containing one conductive layer, with or without stiffeners

Type 2 Double-sided flexible printed wiring containing two conductive layers with plated-through holes, with or without stiffeners

Type 3 Multilayer flexible printed wiring containing three or more conductive layers with plated-through holes, with or without stiffeners

Type 4 Multilayer rigid and flexible material combinations containing three or more conductive layers with plated-through holes

Type 5 Flexible or rigid-flex printed wiring containing two or more conductive layers without plated-through holes

2223 Uses

A - Capable of withstanding flex during installation (flex-to-install)

B - Capable of withstanding continuous flexing for the # of cycles as specified on the master drawing (dynamic flex)

C - High temperature environment (over 105°C)

D - UL recognition

Plating Processes

1 (Acid copper electroplating only)

3 (Acid and/or pyrophosphate copper electroplating)

Final Finish (See IPC-6012 para 1.2.6.2)

S (Solder Coating)

T (Electrodeposited Tin-Lead, (fused))

X (Either Type S or T) – Preferred by our suppliers

SMOBC (Solder Mask over Bare Copper)

IT (immersion tin) is starting to become popular in BGA

ENIG (Electroless nickel, immersion gold) is starting to become popular in BGA

- B. NO IPC-6012 OR IPC-6013 SPECIAL REQUIREMENTS TESTING REQUIRED.
OR

THE FOLLOWING IPC-6012 OR IPC-6013 TESTING REQUIREMENTS APPLY

The following testing can drive cost and lead-time.

(if any are required, see table and call out requirement by title, not paragraph number)

IPC-6012 Special Requirements Testing Table

3.11.4 *Vibration*

3.11.5 *Mechanical Shock*

3.11.9 *Surface Insulation Resistance*

IPC-6013 Special Requirements Testing Table

3.10.1 *Moisture & Insulation Resistance*

3.10.2 *Thermal Shock*

3.10.3 *3.10.3 Cleanliness*

3.10.4 Organic Contamination

3.10.5 Fungus Resistance

3.11.1 Outgassing

If Impedance testing is required, add the following:

IMPEDANCE REQUIREMENTS SHALL BE VERIFIED BY TIME DELAY REFLECTOMETRY (TDR) TEST ON MANUFACTURER SUPPLIED COUPON (SEE NOTE 11 FOR IMPEDANCE REQUIREMENTS).

3.11.2 Impedance TestingRepair

3.11.3 Circuit Repair

3.11.4 Rework

3.11.5 Coefficient of Thermal Expansion (CTE)

C. SUPPLIED TEST COUPON IS IAW IPC-2221

Use this note if you are supplying coupons.

If not, use:

THIS DESIGN DOES NOT INCLUDE QUALITY CONFORMANCE COUPONS. MANUFACTURER SHALL INCORPORATE REPRESENTATIVE COUPONS IAW IPC-2221 AND/OR USE PRODUCTION BOARDS FOR QUALITY CONFORMANCE INSPECTIONS.

3. **MATERIAL REQUIREMENTS:**

MANUFACTURER SHALL SELECT MATERIALS TO ACHIEVE A BALANCED CONSTRUCTION AND TO MEET THE REQUIREMENTS SPECIFIED HEREIN, INCLUDING DIMENSIONAL REQUIREMENTS IN STACKUP VIEW.

A. MATERIAL NOTE FLEX 1

A. MATERIAL NOTE FLEX 1 OPTION

B. MATERIAL NOTE FLEX 2

C. MATERIAL NOTE FLEX 3

4. **CONDUCTOR SPACING:**

CONDUCTOR SPACING ON FINISHED PRODUCT SHALL BE NO LESS THAN:

0.XXX INCH (0.XXX MM). – INTERNAL

0.XXX INCH (0.XXX MM). – EXTERNAL

FOR REFERENCE ONLY: ELECTRONIC DATA MINIMUM SPACING IS 0.XXX INCH (0.XXX MM)

5. **CONDUCTOR WIDTH:**

THE FINISHED CONDUCTOR WIDTH SHALL BE THE NOMINAL ARTWORK

DIMENSION +/-:

0.XXX INCH (0.XXX MM) – INTERNAL

0.XXX INCH (0.XXX MM) - EXTERNAL

FOR REFERENCE ONLY: ELECTRONIC DATA MINIMUM CONDUCTOR WIDTH IS 0.XXX INCH (0.XXX MM).

An optional note selection when controlled impedance signals are part of the design:

CONDUCTOR WIDTH TOLERANCE DOES NOT APPLY TO CONTROLLED IMPEDANCE TRACES.
SEE NOTE 11.

6. **MAXIMUM RATED VOLTAGE:**

THE MAXIMUM RATED VOLTAGE IS XXX VOLTS. THE MANUFACTURER SHALL TEST THE BOARD AT TWICE THE RATED VOLTAGE.

In extreme cases, the following words may be used:

THE MAXIMUM RATED VOLTAGE IS XXX VOLTS EXCEPT BETWEEN POINT A AND B THE MAXIMUM RATED VOLTAGE SHALL BE YYY VOLTS.

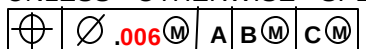
This allows automatic test equipment to be used on the majority of the board and high voltage to be applied to a limited number of traces.

7. **DIMENSIONAL REQUIREMENTS:**

A. DIMENSIONAL LIMITS APPLY AFTER PLATING.

B. HOLE LOCATIONS ARE DEFINED BY THE X-Y COORDINATES IN THE SUPPLIED ELECTRONIC DATA BASED ON THE ESTABLISHED DATUMS.

C. UNLESS OTHERWISE SPECIFIED, ALL PLATED THROUGH HOLES SHALL BE LOCATED



From IPC:

Level A = .009-.010 (0.25 MM) DTP

Level B = .007-.008 (0.2 MM) DTP

Level C = .005-.006 (0.15 MM) DTP

D. UNLESS OTHERWISE SPECIFIED, UNSUPPORTED HOLES SHALL

BE LOCATED

		.010 (M)	A	B (M)	C (M)
---	---	----------	---	-------	-------

E. **0.018** INCH (**0.46** MM) DIAMETER AND SMALLER HOLES MAY BE FILLED WITH SOLDER.

F. DIMENSIONAL MEASUREMENTS SHALL BE IN A RESTRAINED CONDITION. Tolerances in flex sections should be larger than rigid sections due the dimensional stability of the material.

Utilize composite (zone) tolerancing methods to avoid dimensioning across flex sections

8. PLATING AND FINAL FINISH REQUIREMENTS:

Plating Options (reminder, these are exceptions to the plating requirements in Note 2A):

If you say nothing, you'll get solder coating or electrodeposited fused tin-lead IAW IPC-6012

A. **PLATING NOTE 9A** **PLATING NOTE VARIABLE** **ADDITIONAL NOTE TEXT.**

B. **PLATING NOTE 9B**

9. SOLDERMASK/COATING REQUIREMENTS:

A. SOLDERMASK NOTE 9A **SOLDER NOTE VARIABLE** **ADDITIONAL NOTE TEXT.**

B. SOLDERMASK NOTE 9B

10. MARKING:

A. MARK THE FOLLOWING INFORMATION AS APPLICABLE, ON **LAYER 1 OF TEST COUPON AND LAYER XX** SIDE OF THE PRINTED WIRING BOARD PER MIL-STD-130, **0.XX** INCH HIGH CHARACTERS, USING A NON-CONDUCTIVE, EPOXY BASE INK CONTRASTING IN COLOR.

[PART NUMBER, REVISION], MFR-CAGE CODE, **[SERIAL NUMBER]** AND DATE CODE.

Typical minimum character height should not be less than 0.060 inch (1.5 MM) (from IPC-2221).

If location is critical, the detail drawing should show approximate location and refer to this note.
OR

A. MARK IAW IPC-6013 INCLUDING DATE CODE IN THE FORMAT YYWW WHERE YY IS THE LAST 2 DIGITS OF THE YEAR AND WW IS THE CALENDAR WEEK.

IPC-6013 requires traceability, manufacturer's trademark or logo and date code (optional).

If you include part ID number and revision or pattern letter in your artwork, this note best leverages IPC-6013 and is the simplest form.

If location is critical, the detail drawing should show approximate location and refer to this note.

B. MARK LAYER **XX** USING SILKSCREEN LAYER **XX** AND LAYER **YY** USING SILKSCREEN LAYER **YY** USING A NON-CONDUCTIVE, EPOXY BASE INK, CONTRASTING IN COLOR.

C. **SPECIAL NOTE 10C.**

11. IMPEDANCE REQUIREMENTS:

Impedance requirement note text is shown as IMPEDANCE NOTE TEXT.

13. OTHER/OPTIONAL NOTES:

Optional note text is not shown except as RIGID/RIGID FLEX OPTIONAL NOTE 1, RIGID/RIGID FLEX OPTIONAL NOTE 2, RIGID/RIGID FLEX OPTIONAL NOTE 3, RIGID/RIGID FLEX OPTIONAL NOTE 4, RIGID/RIGID FLEX OPTIONAL NOTE 5 and RIGID/RIGID FLEX OPTIONAL NOTE 6.

Problems with Reusing Notes

Problems occur if the notes that deal with “minimum spacing in design” and the “voltage rating” are pulled from a library or cut from a similar board. Designers must manually change all references to minimum spacing and voltage rating according to the design requirements.

During fabrication the note is used to set the lower end spacing requirement in the AOI (Automated Optical Inspection) machine. If the design does not match, it will fail when the machine finds one that is smaller. For example a design has 5-mil spacing occurring on some layers and the note says 8-mil spacing. Using the 8-mil setting in AOI it stops at all the 5-mil spaces and marks them as failures. This example causes a time delay as the errors are reviewed and the note is corrected. A second example would be if the note sets the minimum spacing as 5-mil but the design required 8-mil. The AOI would not stop when it finds a 6-mil segment.

Another example concerns a design that was a power board with an operating voltage of 220 volts. The most common operating voltage, 50 volts, was copied to the drawing because the layout designer did not have the requirement flowed down. This can affect things like dielectric spacing to build up greater separation between those layers and the electrical test of the board, which is twice the rated voltage. So instead of being tested at 500 volts the board was only getting the 100 volt test.

The first generation of the note generator was very primitive. The text for each note was written twice. Dependant information was not checked and could be conflicting. The program was a brute force automation of the typing the notes. No checking for consistency was done. As long as the notes did not change, the program was running okay.

Suggestions came from the users early on that a start form should capture those items that appear in multiple notes. Some of these items are USE, CLASS, and TYPE. Some of the information needed to be expanded into multiple fields. One area where this happened was conductor width. The widths of conductors are dependent on the weight of the copper used on the layer.

HTML directives are embedded in the script. Some of these are defined as variables for consistency. Notetab is a 5 space variable and notetab2 is a 10 space variable. This allows the files to align the output file in an outline format.

Figure 1 - Initial Variables and General Functions

The notetabb variable provides for line alignment. The documented notes should be divided into note text and note variable elements. This allows the program to contain consistent and transferable elements. Note text is loaded into variables that start with the word note followed by the note alphanumeric identification.

Figure 2 - Text Only Note Example

The program provides for the dimensions to be standard units of INCHES with a programmatic conversion to metric dimensions. The `notein_mic` and `notein_mm` variables are used to indicate on the initial form those areas that will be converted to the appropriate metric value. `Notetab2` was to provide a convenient method of formatting the document.

```
/* Pass notes from noteform to notegen */
notesForm.document.write('<INPUT Type="hidden" NAME="note0" VALUE = "", note0,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note1" VALUE = "", note1,"">');
```

Figure 3 - Hidden Variables for Passing Values

Note Types

There are 2 basic types of variables for the generator: the choice variable and the value variable. Each type can be used in combination to build complex notes. The variable name reflects the type. For choice variables, the naming convention is choice[note#][variableID]. The convention for value variables is var[note#][variableID].

Choice Variable

There are two input types used for choice notes: radio and checkbox. The radio is an either/or option where the user must choose one of multiple options as shown in Figure 4. The variableID for radio options is opt. The value for each radio choice must be unique. In the example shown in Figure 4, the note has 2 options. The preferred option is selected by adding the word “checked” to the variable statement. There can only be one checked note for the radio variable. Radio types are not toggles; the programmer should always provide at least two options for this type of variable. If the note is an optional note, the programmer should provide a no choice radio option to allow the user to change their minds when running the generator.

```
<input type="radio" value="V1" name="choice6opt" checked>
<input type="radio" value="V2" name="choice6opt">
```

Figure 4 - Radio choice note example

The checkbox option is a Boolean type variable. Figure 5 has examples of checkbox choice variables. Each of these notes is optional depending on the user's needs. The checkbox provides toggle capability. Since it is a Boolean operator, each checkbox must have a unique name. If the checkbox is used for multiple options for one note, the variableID should be note number and a unique alphanumeric suffix.

```
<input type="checkbox" name="choice8b" value="checkbox">
<input type="checkbox" name="choice8c" value="checkbox">
```

Figure 5 - Checkbox choice note example

Value Variable

The text variable is a “fill in the blank” type input. Figure 6 shows the javascript code for both types of text variables used in the NoteGenerator: text and textarea. The text variable is mainly used to allow a single alphanumeric value. If the value is a measurement, the appropriate conversion indicator is also added to provide the user with additional information. The textarea variable is currently used in only one place. Note 1 to allow for easy insertion of site-specific notes into the generated output. Except for this one area, all other site-specific notes are added at the end of the generated notes.

```
<input type="text" name="var3a" size="5">
<textarea rows="2" name="var1extra" cols="60"></textarea>
```

Figure 6 - Text Value Note Example

Another type of variable note is the list box format. This format allows the user to choose from a specific list of options. Options can be set for restricting choice to one item. Using the word “multiple” enables the user to select several of the options or all of the items. Figure 7 is an example of a list box with multiple item selection enabled.

```
<select size="9" name="note2b_testing" multiple>
<option value="OUTGASSING">3.11.1 Outgassing</option>;
<option value="ORGANIC CONTAMINATION">3.11.2 Organic Contamination</option>;
<option value="FUNGUS RESISTANCE">3.11.3 Fungus Resistance</option>;
<option value="VIBRATION">3.11.4 Vibration</option>;
<option value="MECHANICAL SHOCK">3.11.5 Mechanical Shock</option>;
<option value="IMPEDANCE TESTING">3.11.6 Impedance Testing</option>
```

Figure 7 - List Box Value Note Example

Technology Boolean

The final component of the generator is the technology operation. For the fabrication notes documented in Lists 1 and 2, the variables are rigid and rf. The technology Boolean will be selected to determine the proper note is written.

The program files have been included as an appendix in this document and as a zip file for the procedures. This program is run via an web browser and the output is saved to a text file or copied and pasted into the CAD drawing.

Future Direction

The current implementation of the PWB Fabrication Note Generator utilizes JavaScript with hard coded data to create notes. Though perfectly functional this carries with it several limitations. Any content changes are labor intensive, as it requires code to be edited by hand. This creates a steep learning curve for those without prior programming knowledge. The chance for human error is also increased as the functional elements of the program can be affected while changing content.

The generation of the PWB Fabrication Note Generator currently in development is aimed at eliminating some of the constraints of the current design. Content management and design flexibility have been increased and the learning curve sharply reduced. In an effort to drive usability the entire user interface will be web based. Changes can be comfortably made from any web browser on any platform all without requiring the skills of a programmer. These advancements in design have been made possible by using a MySQL database abstracted by Perl, which delivers a robust and scalable application.

Using a database makes content more versatile as formatting is stored separately. This allows for changes in formatting to be represented throughout the entire document instantly. Another derived benefit is the reduction of data redundancy that would normally be found in a static design. Content can be reused and applied in more than one location throughout the tool without unnecessary reentry.

Server side Perl, which provides the database abstraction, lifts browser constraints allowing a broader range of users to access and modify the tool. This solves the issue of requiring users to have JavaScript enabled browsers. Perl allows the notes creator to store HTML elements alongside plaintext while dynamically extracting form values upon user input. The Perl script will automatically recognize when a choice is available by creating radio buttons on the user input page. This occurs when more than one note topic number or subtopic letter is present. Check boxes are created when a section is flagged as optional.

The construction of the end user interface is very similar to the current version. The user is presented with three pages. The first contains a list of options, which limit and categorize the selections on the following pages. Among these options is a choice to output Rigid Notes, or Flex Notes. The proceeding page is shaped according to this choice. The second page lists all of the note topics and subtopics defined by the context set on the previous page. After further user input the final note generation appears on the third page.

Forward thinking in mind, the new architecture provides a stable platform for which new features can be easily added. Perl's extensive language opens up new possibilities that were unavailable in JavaScript. With the content stored separately in a database new applications may be created without any recoding needed.

Main HTML Page

S37-1-12

[illegible]

Drawing Note Generator

Appendix

Yes <input type="radio" name="TestCoupons" value="V2" checked> No</p>
<p>The dimensional requirements will be presented in a stackup
 <select size="1" name="note3mod">
 <option selected value="VIEW">VIEW</option>
 <option value="TABLE">TABLE (Rigid board only)</option>
 </select>
 <p>Internal minimum conductor spacing: <input type="text" name="ConductorSpaceInt" size="8"
value=".000">
 Inch</p>
 <p>External minimum conductor spacing: <input type="text" name="ConductorSpaceExt" size="7"
value=".000">
 Inch</p>
 <p>Electronic Data Minimum Conductor Spacing: <input type="text" name="eDataSpaceMin" size="8"
value=".000">
 Inch</p>
 <p>Electronic Data Minimum Conductor Width: <input type="text" name="eDataWidthMin" size="8"
value=".000">
 Inch</p>
 <p>Maximum diameter for solder filled holes: <input type="text" name="MaxDiaFillHole" size="8"
value="0.018"></p>
 <p>Maximum Rated Voltage: <input type="text" name="MaxRateVolt" size="8" value="000">
 Volts</p>
</blockquote>
<p><input type="button" value="Create Note Form" onClick="makeForm()"><input type="reset"
value="Reset" name="B2"></p>
</form>

<p> </p>

</html>

Drawing Note Generator Appendix

JavaScript Program – noteform.js

```

/** noteform.js
/** Coded for EPI by Karen McConnell
/** Modified for EPI by Karen McConnell 0/14/2003
/** =====
/** Description:
/** Creates the appropriate form to select items to make PWB Fabrication notes.
/** =====
/** Associated Files / Notes:
/** Note: If you are updating this file, make sure and do the same
/** Updates for the other ones in /home/web/docs/javascript/webapps/
/** The files in webapps are used for the external site
/** database driven sites. So they need to be kept up to date as well.
/** 
/** Other files: notegen.js uses these arrays in processing the menu
/** =====
/** Version History:
/** Version 2.1 - January 21, 2002
/** Version 3.1 - Alpha Jan 2003 - today
/** Version IPC - Modified for the IPC 2004 APEXPO Designer's Summit
/** =====

function makeForm() {

var debug = false;
var rigid = false;
var rf = false;
var flex = false;
var IPCTest = false;
var coupons = false;
var use = "Rigid/Flex variable only";
var docFam = "0";
var note3arf = " ";
var red = "#FF0000";
var note3bplus = " ";
var note3d = " ";
var note3dplus = " ";
var note3flam = " ";
var note3fnolam = " ";
var note3fcompletelam = " ";
var notetab = "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&~<br>notetab2 = notetab + notetab;

/** Set up Standard and Metric variable to show Metric units as xx in red
notein_mic = "INCH (<font color="
+ red
+ ">xx</font> MICROMETERS)";
notein_mm = "INCH (<font color="
+ red
+ ">xx</font> MM);

notesForm                                     =                               window.open("", "NoteForm",
"menubar=yes,toolbar=yes,location=yes,scrollbars=yes,resizable=yes");

```

Drawing Note Generator Appendix

```
if (document.generator.Technology[0].checked ){
    rigid = true;
    technology = "Rigid";
}
if (document.generator.Technology[1].checked ){
    rf = true;
    technology = "Rigid/Flex";
}

/** Assignment of variables for writing form and passing to notegen.js
/** Assign logic operators

if (document.generator.DocumentFamily[0].checked){
    docFam = "1";
}
if (document.generator.DocumentFamily[1].checked){
    docFam = "2";
}
if (document.generator.DocumentFamily[2].checked){
    docFam = "3";
}

if (document.generator.SpecialTest[0].checked) {
    IPCtest = true;
}
if (document.generator.TestCoupons[0].checked) {
    coupons = true;
}
/** Set alpha-numeric values

type = document.generator.type[document.generator.type.selectedIndex].value;
ipcclass = document.generator.ipcclass[document.generator.ipcclass.selectedIndex].value;
level = document.generator.level[document.generator.level.selectedIndex].value;

if (rf){
    use = document.generator.use[document.generator.use.selectedIndex].value;
}

plating = document.generator.plating[document.generator.plating.selectedIndex].value;
finish = document.generator.finish[document.generator.finish.selectedIndex].value;
MinSpaceInt = document.generator.ConductorSpaceInt.value;
MinSpaceExt = document.generator.ConductorSpaceExt.value;
eDataMinSpace = document.generator.eDataSpaceMin.value;
eDataMinWidth = document.generator.eDataWidthMin.value;
MRV = document.generator.MaxRateVolt.value;
MaxDiaSolderHole = document.generator.MaxDiaFillHole.value;

/* Note creation - all note text is assigned to a variable.
The variables are named for their note number and letter with alphanumeric suffixes when more than
one note is needed for the form. */

note0 = "NOTES: UNLESS OTHERWISE SPECIFIED:<br>";

/* Create variable for note 1 */
```

Drawing Note Generator Appendix

```
note1 = "1. INTERPRET THIS DRAWING IN ACCORDANCE WITH (IAW) THE FOLLOWING"
+ "<br>"
+ notetab
+ "STANDARDS/SPECIFICATIONS:";
if (rigid){
    note1a = notetab
    + "A. IPC-2221 AND IPC-2222 TYPE ,"
        + type
        + ", CLASS "
        + ipcclass
        + ", LEVEL "
        + level
        + ". (DESIGN)";
}
else {
    note1a = notetab
    + "A. IPC-2221 AND IPC-2223 TYPE ,"
        + type
        + " USE "
        + use
        + ", CLASS "
        + ipcclass
        + ", LEVEL "
        + level
        + ". (DESIGN)";
}

/* Create variables for note 2 */
note2 = "2. QUALIFICATION AND PERFORMANCE REQUIREMENTS:"
if (rigid){
    if (docFam == 1){
        note2a = notetab
        + "A. IPC-6011 AND IPC-6012 TYPE ,"
            + type
            + ", CLASS "
            + ipcclass
            + ", PLATING PROCESS "
            + plating
            + ", FINAL FINISH "
            + finish
            + ". ";
    }
    else {
        if (docFam == 2){
            note2a = notetab
            + "A. LOCKHEED MARTIN 00000000 (CAGE CODE: #####).";
        }
        else {
            note2a = notetab
            + "A. LM#####.";
        }
    }
}
else {
    note2a = notetab
```

[illegible]

[illegible]

```

if (rigid){
    note3a = notetab
+ "A. LAMINATE AND PREPREG MATERIALS PER IPC-4101/";
    note3b = notetab
+ "B. COPPER FOIL SHALL BE IN ACCORDANCE WITH IPC-4562/"
    note3bplus = ", QUALITY CLASSIFICATION ";
    note3c = notetab
+ "C. THE MINIMUM NUMBER OF REINFORCING LAYERS BETWEEN ADJACENT"
        + "<br>"
+ notetab2
+ "CONDUCTIVE LAYERS SHALL BE TWO.";
}

```

```
notede = "THE MINIMUM DIELECTRIC SPACING SHALL BE ";
notederf1 = " ON THE RIGID DIELECTRIC";
notederf2 = " ON THE FLEX DIELECTRIC";
note3g = notetab
```

Drawing Note Generator Appendix

```
+ "G. OTHER MATERIALS:"
+ "<br>"
+ notetab2
+ "DELIVERABLE MATERIALS NOT SPECIFIED ON DRAWING OR SPECIFICATION"
+ "<br>"
+ notetab2
+ "REQUIRE PRIOR APPROVAL FROM ";

/* Create form for note 4 */

note4 = "4. CONDUCTOR SPACING:"
+ "<br>"
+ notetab
+ "CONDUCTOR SPACING ON FINISHED PRODUCT SHALL BE NO LESS THAN:";
note4plus = notetab
+ "FOR REFERENCE ONLY: ELECTRONIC DATA MINIMUM SPACING IS ";

/* Create form for note 5 */

note5 = "5. CONDUCTOR WIDTH:"
+ "<br>"
+ notetab
+ "THE FINISHED CONDUCTOR WIDTH SHALL BE THE NOMINAL ARTWORK DIMENSION
+/-:";
note5plus = notetab
+ "FOR REFERENCE ONLY: ELECTRONIC DATA MINIMUM CONDUCTOR WIDTH IS ";
note5opt = "<br>"
+ notetab
+ "CONDUCTOR WIDTH TOLERANCE DOES NOT APPLY TO CONTROLLED IMPEDANCE
TRACES."
+ "<br>"
+ notetab
+ "SEE NOTE 11.";

/* Create form for note 6 */
note6 = "6. MAXIMUM RATED VOLTAGE:"
+ "<br>"
+ notetab
+ "THE MAXIMUM RATED VOLTAGE IS "
+ MRV
+ " VOLTS.";
note6opt = "6. MAXIMUM RATED VOLTAGE:"
+ "<br>"
+ notetab
+ "THE MAXIMUM RATED VOLTAGE IS "
+ MRV
+ " VOLTS EXCEPT BETWEEN"
+ "<br>"
+ notetab
+ "POINT ";
note6opt1 = "THE MAXIMUM RATE VOLTAGE"
+ "<br>"
+ notetab
+ "SHALL BE ";
note6rf = notetab
```

Drawing Note Generator

Appendix

+ "THE MANUFACTURER SHALL TEST THE BOARD AT TWICE THE RATED VOLTAGE.";

/* Create form for note 7 */

note7 = "7. DIMENSIONAL REQUIREMENTS:"

note7a = notetab

+ "A. DIMENSIONAL LIMITS APPLY AFTER PLATING.";

note7b = notetab

+ "B. HOLE LOCATIONS ARE DEFINED BY THE X-Y COORDINATES IN THE SUPPLIED"

+ "
"

+ notetab2

+ "ELECTRONIC DATA BASED ON THE ESTABLISHED DATUMS.";

note7c = notetab

+ "C. UNLESS OTHERWISE SPECIFIED, ALL PLATED THROUGH HOLES SHALL BE LOCATED ";

note7d = notetab

+ "D. UNLESS OTHERWISE SPECIFIED, UNSUPPORTED HOLES SHALL BE LOCATED" ;

note7e1 = notetab

+ "E. ";

note7e2 = " DIAMETER AND SMALLER HOLES MAY BE FILLED WITH SOLDER.";

note7f = notetab2

+ "F. DIMENSIONAL MEASUREMENTS SHALL BE IN A RESTRAINED CONDITION.";

/* Create form for note 8 */

note8 = "PLATING AND FINAL FINISH REQUIREMENTS:"

if (rigid){

note8 = "8. "

+ note8;

}

else {

note8 = "8. SPECIAL "

+ note8;

}

/* Options for note8a */

note8a = notetab

+ "A. PLATING AND FINAL FINISH REQUIREMENTS ARE IAW IPC-6012.";

note8a1a = notetab

+ "A. PLATING NOTE 8A CHOICE 1 ";

note8a1b = " REST OF PLATING NOTE 8A.";

note8a2 = notetab

+ "A. PLATING NOTE 8A CHOICE 2 ";

note8a3 = notetab

+ "A. PLATING NOTE 8A CHOICE 3 ";

note8b1 = notetab

+ "B. PLATING NOTE 8B ";

/* Create form for note 9 */

note9 = "9. SOLDERMASK/COATING REQUIREMENTS:";

note9a1 = notetab

+ "A. SOLDERMASK NOTE 9A";

note9a2 = " ADDITIONAL NOTE TEXT.";

note9b1 = notetab

Drawing Note Generator Appendix

```
+ "B. SOLDERMASK NOTE 9B";

/* Create form for note 10 */
note10 = "10. MARKING:";

note10a1 = notetab
    + "A. MARK THE FOLLOWING INFORMATION AS APPLICABLE, ON ";
note10a1opt = "LAYER 1 OF TEST COUPON AND ";
note10a2 = "LAYER ";
note10a3 = "<br>"
    + notetab2
    + "SIDE OF THE PRINTED WIRING BOARD PER MIL-STD-130, ";
note10a4 = " INCH HIGH CHARACTERS,"
    + "<br>"
    + notetab2;
    + "USING A NON-CONDUCTIVE, EPOXY BASE INK CONTRASTING IN COLOR,"
    + "<br>"
    + notetab2;
note10a4opt = "PART NUMBER, REVISION, ";
note10a5 = "MFR-CAGE CODE, ";
note10a5opt = "SERIAL NUMBER, ";
note10a6 = " AND DATE CODE.";
note10aopt = notetab
    + "A. MARK IAW IPC-6012 INCLUDING DATE CODE IN THE FORMAT YYWW WHERE YY
IS THE LAST 2 DIGITS"
    + "<br>"
    + notetab2
    + "OF THE YEAR AND WW IS THE CALENDAR WEEK.";

note10b1 = notetab
    + "B. MARK LAYER ";
note10b2 = " USING SILKSCREEN LAYER ";
note10b3 = " AND LAYER ";
note10b4 = " USING SILKSCREEN LAYER ";
note10b5 = "<br>"
    + notetab2
    + "USING A NON-CONDUCTIVE, EPOXY BASE INK, CONTRASTING IN COLOR.";

note10c = notetab
    + "C. SPECIAL NOTE 10C.";

/* Create form for note 11 */

note11 = "11. IMPEDANCE REQUIREMENTS:";
note11a1 = "IMPEDANCE NOTE TEXT.";

/* Create form for note 12 */

note12 = "12. OTHER/OPTIONAL NOTES:";
note12a1 = "NOTE 12 (1)";
note12a2 = notetab2
    + "NOTE 12 (1) ADDITIONAL TEXT ";
note12a3 = "<br>"
    + notetab2
    + " NOTE 12 (1) MORE TEXT ";
```

Drawing Note Generator Appendix

```
note12a4 = ".";

note12b = "NOTE 12 (2).";

note12c1 = "NOTE 12 (3).";

note12dr1 = "NOTE 12 (4) RIGID ONLY.";
note12df1 = "NOTE 12 (4) RIGID/FLEX ONLY.";

note12e1 = "NOTE 12 (5) OPT 1.";
note12e2 = "NOTE 12 (5) OPT 2.";

note12f1 = "NOTE 12 (6).";

note12g1 = "NOTE 12 (7).";

note12h1 = "NOTE 12 (8). ";
note12h2 = "NOTE 12 (8.2).";

/** Start writing to new window

notesForm.document.write('<HTML><HEAD><TITLE>GENERATED WINDOW</TITLE>');
notesForm.document.write('<script language="JavaScript" SRC="notegen.js">');
notesForm.document.write('</script></HEAD>');
notesForm.document.write('<BODY BGCOLOR=WHITE><H2>', technology, '&nbsp;Note
Generator</H2> <form name="fab" method="post" >');

/** Write variables - for debug uses
if (debug){
    notesForm.document.write("Type: ', type, '<br>');
    notesForm.document.write('Class: ', ipcclass, '<br>');
    notesForm.document.write('Level: ', level, '<br>');
    notesForm.document.write('Plating: ', plating, '<br>');
    notesForm.document.write('Finish: ', finish, '<br>');
    notesForm.document.write('Use: ', use, '<br>');
    notesForm.document.write('docFam: ', docFam, '<br>');
    notesForm.document.write('IPCTest: ', IPCtest, '<br>');
    notesForm.document.write('Coupon: ', coupons, '<br>');
    notesForm.document.write('Min Conductor Space Internal: ', MinSpaceInt, '<br>Min Conductor Space
Internal: ', MinSpaceExt, '<br>eData Min Space: ', eDataMinSpace, '<br>');
    notesForm.document.write('eData Min Width: ', eDataMinWidth, '<br>');
    notesForm.document.write('Min Rated Voltage: ', MRV, '<br>');
    notesForm.document.write('Maximum diameter for solder filled holes: ', MaxDiaSolderHole, '<br>');
    notesForm.document.write('<br>Last line of debug<br><br>');
}

/** Write form for notegen.js script

notesForm.document.write('Version 3.0<br><br>');
notesForm.document.write('Color Codes:<br>');
notesForm.document.write('<font color="#FF0000"><strike>Red indicates variable values to be filled
in</strike><br></font>');
notesForm.document.write('<font color="#FF0000"><i>Note: Red text from the document has been
replaced by pull down lists and dialog boxes.<br>');
```

Drawing Note Generator Appendix

```
notesForm.document.write('&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&~<br>document denotes place holders for values calculated by the script.</i></font><br>');
notesForm.document.write('<font color="#0000FF">Blue indicates optional wording</font><br>');
notesForm.document.write('<font color="#008000">Green indicates references to help determine proper
noteselection. Do not include in actual drawing note.</font><br>');
notesForm.document.write('Variables and info herein are LMC recommendations and are not intended to
be all inclusive.<br>');
notesForm.document.write('<hr>');
```

```
notesForm.document.write('<table border="1">');
notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;  </td>');
notesForm.document.write('<td>',note0,'</td>');
notesForm.document.write('</tr>');
```

```

/* Write form for Note 1 */
/* write text in note form so they can be passed to notegen program */
notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;  </td>');
notesForm.document.write('<td>', note1, '<br></td>');
notesForm.document.write('</tr>');
notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;  </td>');
notesForm.document.write('<td>', note1a, '</td>');
notesForm.document.write('</tr>');

```

```
notesForm.document.write(' <tr>');
notesForm.document.write(' <td>&nbsp;</td>');
notesForm.document.write('<td><font color="#008000">B. Any others as required<br>');
notesForm.document.write('(Use CAPS to enter -- start each line with alpha beginning with "B."<br>');
notesForm.document.write('(For a carriage return in the final document at a &quot;&lt;br>&gt;&quot; - do
not use quote marks.</font><br>');
notesForm.document.write('<textarea rows="2" name=var1extra cols="60"></textarea><br></td>');
notesForm.document.write(' </tr>');
```

```
/* Write form for Note 2 */
notesForm.document.write(' <tr>');
notesForm.document.write(' <td>&nbsp;  </td>');
notesForm.document.write('<td>', note2, '<br>');
notesForm.document.write('</tr>');
```

```
notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;  </td>');
notesForm.document.write('<td>', note2a, '<br>', note2a1, '<br>');
notesForm.document.write('</tr>');
```

```
notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;</td>');
notesForm.document.write('<td>&nbsp;</td>');
    if (IPCTest){
        if (rigid){
```

Drawing Note Generator Appendix

```

        notesForm.document.write('<font color="#008000">The following testing can drive
cost and lead-time</font><br>');
        notesForm.document.write('<select size="9" name="var2b1" multiple>');
        notesForm.document.write('<option                                value="OUTGASSING">3.11.1
Outgassing</option>');
        notesForm.document.write('<option value="ORGANIC CONTAMINATION">3.11.2
Organic Contamination</option>');
        notesForm.document.write('<option value="FUNGUS RESISTANCE">3.11.3 Fungus
Resistance</option>');
        notesForm.document.write('<option                                value="VIBRATION">3.11.4
Vibration</option>');
        notesForm.document.write('<option value="MECHANICAL SHOCK">3.11.5
Mechanical Shock</option>');
        notesForm.document.write('<option value="IMPEDANCE TESTING">3.11.6
Impedance Testing</option>');
    }
    else {
        notesForm.document.write('<font color="#008000">The following testing can drive
cost and lead-time</font><br>');
        notesForm.document.write('<select size="9" name="var2b1" multiple>');
        notesForm.document.write('<option value="OUTGASSING">3.11.1 Outgassing
</option>');
        notesForm.document.write('<option value="ORGANIC CONTAMINATION">3.11.2
Organic Contamination </option>');
        notesForm.document.write('<option value="FUNGUS RESISTANCE">3.11.3 Fungus
Resistance </option>');
        notesForm.document.write('<option value=" VIBRATION">3.11.4 Vibration
</option>');
        notesForm.document.write('<option value="MECHANICAL SHOCK">3.11.5
Mechanical Shock</option>');
        notesForm.document.write('<option value="SIR">3.11.9 Surface Insulation Resistance
</option>');
        notesForm.document.write('<option value="IMPEDANCE TESTING">3.11.6
Impedance Testing</option>');
    }
    }
    else {
        notesForm.document.write(note2b, '<br>');
    }
}
notesForm.document.write('</td></tr>');

notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;</td>');
notesForm.document.write('<td>&nbsp;</td>');
notesForm.document.write(note2c, '<br>');
notesForm.document.write('</td></tr>');

/* Write form for Note 3 */
notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;</td>');
notesForm.document.write('<td>',note3);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

if (rigid){

```

Drawing Note Generator Appendix

```

        notesForm.document.write('<tr>');
        notesForm.document.write('<td    valign="top"><input    type="radio"    name="choice3opt"
value="0"></td>');
        notesForm.document.write('<td>',note3opt);
        notesForm.document.write('</td>');
        notesForm.document.write('</tr>');
    }

notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;  </td>');
notesForm.document.write('<td>',note3a);

if (rigid){
    notesForm.document.write('<select size="1" name="var3a">');
    notesForm.document.write('<option value="21">21</option>');
    notesForm.document.write('<option value="24">24</option>');
    notesForm.document.write('<option value="40">40</option>');
    notesForm.document.write('<option value="41">41</option>');
    notesForm.document.write('<option value="42">42</option>');
    notesForm.document.write('<option value="53">53</option>');
    notesForm.document.write('<option value="55">55</option>');
    notesForm.document.write('<option value="70">70</option>');
    notesForm.document.write('<option value="71">71</option>');
    notesForm.document.write('</select>');
    notesForm.document.write(notetab2, ' <br><font color="#0000FF">(Optionally add TYPE
&nbsp;  <input type="text" name="option3a" size="5">, i.e. GFN, GIN, etc.).<br></font>');
}
else {
    notesForm.document.write('<select size="1" name="var3a">');
    notesForm.document.write('<option value="1">1</option>');
    notesForm.document.write('<option value="11">11</option>');
    notesForm.document.write('</select>');
    notesForm.document.write('<br>', note3arf);
}

notesForm.document.write('.');
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;  </td>');

if (rigid){
    notesForm.document.write('<td>',note3b, ' ');
    notesForm.document.write('<select size="1" name="slash3b">');
    notesForm.document.write('<option value="1">1</option>');
    notesForm.document.write('<option value="2">2</option>');
    notesForm.document.write('<option value="3">3</option>');
    notesForm.document.write('<option value="4">4</option>');
    notesForm.document.write('<option value="5">5</option>');
    notesForm.document.write('<option value="6">6</option>');
    notesForm.document.write('<option value="7">7</option>');
    notesForm.document.write('<option value="8">8</option>');
    notesForm.document.write('<option value="9">9</option>');
    notesForm.document.write('<option value="10">10</option>');

```

Drawing Note Generator Appendix

```

notesForm.document.write('<option value="11">11</option>');
notesForm.document.write('</select>');
notesForm.document.write(', ');
notesForm.document.write(note3bplus);
    notesForm.document.write('<select size="1" name="qualclass3b">');
notesForm.document.write('<option value="1">1</option>');
notesForm.document.write('<option value="2">2</option>');
notesForm.document.write('<option value="3">3</option>');
notesForm.document.write('</select>');
}
else {
    notesForm.document.write('<td>',note3b, ' ');
}

notesForm.document.write('.');
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>');

notesForm.document.write('<td>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;',note3c);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>');

if (rigid){
    notesForm.document.write('<td>', notetab2, 'D.', notede, '<input
name="min_dielectric_space" size="7" value=".0035">', notein_mic);
}
else {
    notesForm.document.write('<td>', notetab, note3d, ' ');
    notesForm.document.write('<select size="1" name="slash3d">');
notesForm.document.write('<option value="1">1</option>');
notesForm.document.write('<option value="2">2</option>');
notesForm.document.write('<option value="3">3</option>');
notesForm.document.write('<option value="4">4</option>');
notesForm.document.write('<option value="5">5</option>');
notesForm.document.write('<option value="6">6</option>');
notesForm.document.write('<option value="7">7</option>');
notesForm.document.write('<option value="8">8</option>');
notesForm.document.write('<option value="9">9</option>');
notesForm.document.write('<option value="10">10</option>');
notesForm.document.write('<option value="11">11</option>');
notesForm.document.write('</select>');
notesForm.document.write(note3dplus);
    notesForm.document.write('<select size="1" name="qualclass3d">');
notesForm.document.write('<option value="1">1</option>');
notesForm.document.write('<option value="2">2</option>');
notesForm.document.write('<option value="3">3</option>');
notesForm.document.write('</select>');
    notesForm.document.write('</td>');
}

```

Drawing Note Generator Appendix

```

notesForm.document.write('</tr>');

notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;</td>');

    notesForm.document.write('<td>&nbsp;<input type="text"
name="min_dielectric_space_rf" size="7" value=".0035">', notein_mic, notederf1, ". ");
    notesForm.document.write('&nbsp;<input type="text" name="min_dielectric_space"
size="7" value=".0035">', notein_mic, notederf2);
    notesForm.document.write('</td>');
    notesForm.document.write('</tr>');

notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;</td>');

    notesForm.document.write('<td>&nbsp;F.', note3flam,<input type="text" name="note3flamx"
size="3" value="X">', ' THROUGH ',
    '<input type="text" name="note3flamy" size="3" value="Y">', note3fnolam, '<input type="text"
name="note3fnolamx" size="3" value="X">', ' AND ',
    '<input type="text" name="note3fnolamy" size="3" value="Y">', ' LAYERS ', '<input type="text"
name="note3fcompletelamx" size="3" value="X">', ' THROUGH ',
    '<input type="text" name="note3fcompletelamy" size="3" value="Y">', note3fcompletelam);
    notesForm.document.write('<tr>');
    notesForm.document.write('<td align="top"><input type="radio" name="choice3gopt"
value="0"></td>');
    notesForm.document.write('<td>&nbsp;',note3g, '&nbsp;');
    notesForm.document.write('<input type="text" name="note3gextra" size="60" value="LIST
YOUR COMPANY"><br>');
    }

notesForm.document.write('.');
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

/* Write form for Note 4 */

notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;</td>');
notesForm.document.write('<td>',note4);
notesForm.document.write('<br>');
notesForm.document.write(notetab,notetab);
notesForm.document.write(MinSpaceInt);
notesForm.document.write(notein_mm);
notesForm.document.write('- INTERNAL');
notesForm.document.write('<br>');
notesForm.document.write(notetab,notetab);
notesForm.document.write(MinSpaceExt);
notesForm.document.write(notein_mm);
notesForm.document.write('- EXTERNAL');
notesForm.document.write('<br>');

notesForm.document.write(note4plus, '&nbsp;', eDataMinSpace);
notesForm.document.write(notein_mm);

```

Drawing Note Generator Appendix

```

notesForm.document.write('.');
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

/* Write form for Note 5 */
/* Need to determine how to do the optional internal copper weights */
notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;  </td>');
notesForm.document.write('<td>',note5);
notesForm.document.write('<br>');
notesForm.document.write(notetab,notetab);
notesForm.document.write('<input type="text" name="internal_conduct_width" size="6" value=".XXX">');
notesForm.document.write(notein_mm);
notesForm.document.write('- INTERNAL');
notesForm.document.write('<br>');
notesForm.document.write(notetab,notetab);
notesForm.document.write('<input          type="text"          name="external_conduct_width"          size="6" value=".XXX">');
notesForm.document.write(notein_mm);
notesForm.document.write('- EXTERNAL<br>');
notesForm.document.write(note5plus, '&nbsp;  ', eDataMinWidth);
notesForm.document.write(notein_mm);

notesForm.document.write('.');
notesForm.document.write('</td>');
notesForm.document.write('</tr>');


/* Write form for Note 6 */
notesForm.document.write('<tr>');
notesForm.document.write('<td align="top"><input type="radio" value="V1" name="choice6opt" checked></td>');
notesForm.document.write('<td>',note6);
if (rf){
    notesForm.document.write('<br>', note6rf);
}
notesForm.document.write('<tr><td align="top"><input type="radio" value="V2" name="choice6opt"></td>');
notesForm.document.write('<td><font color="#008000">In extreme cases the following words may be used </font><br>');
notesForm.document.write('&nbsp;',note6opt, '<input type="text" name="pointa" size="6" value="A"> AND <input type="text" name="pointb" size="6" value="B">', note6opt1, '<input type="text" name="MRVopt" size="6" value="YYY"> VOLTS');
notesForm.document.write('.');

notesForm.document.write('</td>');
notesForm.document.write('</tr>');


/* Write form for Note 7 */
notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;  </td>');
notesForm.document.write('<td>',note7, '<br>');
notesForm.document.write( note7a, '<br>');

```

Drawing Note Generator Appendix

```

notesForm.document.write( note7b, '<br>');
notesForm.document.write( note7c, '<br>', notetab2, '.<br>');
notesForm.document.write(notetab, '<font color="#008000"><i>Graphic will need to be added to the notes
via the CAD system.</i></font><br>');
notesForm.document.write( note7d, '<br>', notetab2, '</span><br>');
notesForm.document.write(notetab, '<font color="#008000"><i>Graphic will need to be added to the notes
via the CAD system.</i></font><br>');
notesForm.document.write(note7e1, MaxDiaSolderHole, '&nbsp;'); notein_mm, note7e2, '<br>');
if (rf){
    notesForm.document.write( note7f, '<br>');
}

notesForm.document.write('</td>');
notesForm.document.write('</tr>');

/* Write form for Note 8 */
notesForm.document.write('<tr>');
notesForm.document.write('<td>&nbsp;</td>');
notesForm.document.write('<td>', note8, '<br>');
notesForm.document.write('</td>');
notesForm.document.write('</tr>');
notesForm.document.write('<tr><td valign="top"><input type="radio" value="V1" name="choice8a"
checked ></td>');
notesForm.document.write('<td>');
notesForm.document.write('<font color="#008000">');
notesForm.document.write('Plating Options (reminder, these are exceptions to the plating requirements in
Note 2A):<br>');
notesForm.document.write('If you say nothing, you'll get solder coating or electrodeposited fused tin-lead
IAW IPC-6012 ');
notesForm.document.write('</font>');
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td valign="top"><input type="radio" value="V2" name="choice8a"
selected></td>');
notesForm.document.write('<td>');
notesForm.document.write('&nbsp;', note8a1a, '<input type="text" name="var8a1a" size="6"
value=".0003">', notein_mic, note8a1b);

notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td valign="top"><input type="radio" value="V3"
name="choice8a"></td>');
notesForm.document.write('<td>');
notesForm.document.write('&nbsp;', note8a2);

notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td valign="top"><input type="radio" value="V4"
name="choice8a"></td>');

```

Drawing Note Generator

Appendix

```
notesForm.document.write('<td>');
notesForm.document.write('&nbsp;','note8a3);

notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td align="top"><input type="checkbox" name="choice8b"
value="checkbox"></td>');

notesForm.document.write('<td>');
notesForm.document.write('&nbsp;','note8b1, <input type="text" name="var8a1" size="6"
value=".0001">');

notesForm.document.write('</td>');
notesForm.document.write('</tr>');

/* Write form for Note 9 */

notesForm.document.write('<tr><td align="top">&nbsp;</td>');
notesForm.document.write('<td>');
notesForm.document.write('&nbsp;','note9);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td align="top">&nbsp;</td>');
notesForm.document.write('<td>');
notesForm.document.write('&nbsp;','note9a1,<input type="text" name="var9a1" size="12"
value="SOLDER NOTE VARIABLE">', note9a2);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td align="top"><input type="checkbox" value="checkbox"
name="choice9b"></td>');
notesForm.document.write('<td>');
notesForm.document.write('&nbsp;','note9b1);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

/* Write form for Note 10 */
notesForm.document.write('<tr><td align="top">&nbsp;</td>');
notesForm.document.write('<td>');
notesForm.document.write('&nbsp;','note10);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td align="top"><input type="Radio" name="choice10a" value="V1"
checked></td>');
notesForm.document.write('<td>');
notesForm.document.write('&nbsp;','note10a1);
notesForm.document.write('<input type="checkbox" value="checkbox" name="choice10aopt1"><font
color="#0000FF">', note10a1opt,</font>');
notesForm.document.write(note10a2, '<input type="Text" value="XX" name="var10a1" size="2">',
note10a3);
notesForm.document.write('<input type="Text" value="XX" name="var10a2" size="4">');
```

Drawing Note Generator Appendix

```

notesForm.document.write(note10a4);
notesForm.document.write('<input type="checkbox" value="checkbox" name="choice10aopt4"><font
color="#0000FF">', note10a4opt,'</font>');
notesForm.document.write(note10a5);
notesForm.document.write('<input type="checkbox" value="checkbox" name="choice10aopt5"><font
color="#0000FF">', note10a5opt,'</font>');
notesForm.document.write(note10a6);
notesForm.document.write('<font color="#008000">');
notesForm.document.write('<br><i>Typical minimum character height should not be less than .060 inch
(1.5 MM) (from IPC-2221).</i>');
notesForm.document.write('<br>If location is critical, the detail drawing should show approximate location
and refer to this note. ');
notesForm.document.write('</font>');
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td align="top"><input type="Radio" name="choice10a"
value="V2"></td>');
notesForm.document.write('<td>');
notesForm.document.write('&nbsp;',note10aopt);
notesForm.document.write('<font color="#008000">');
notesForm.document.write('<br>IPC-6012 requires traceability, manufacturer's trademark or logo and date
code (optional). ');
notesForm.document.write('<br>If you include part ID number and revision or pattern letter in your
artwork, this note best leverages IPC-6012 and is the simplest form. ');
notesForm.document.write('<br>If location is critical, the detail drawing should show approximate location
and refer to this note. ');
notesForm.document.write('</font>');
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td>&nbsp;</td>');
notesForm.document.write('<td>');
notesForm.document.write('&nbsp;',note10b1, '<input type="Text" name="var10b1" value="XX"
size="2">', note10b2);
notesForm.document.write('<input type="Text" name="var10b2" value="XX" size="2">');
notesForm.document.write(note10b3, '<input type="Text" name="var10b3" value="YY"
size="2">',note10b4);
notesForm.document.write('<input type="Text" name="var10b4" value="YY" size="2">',note10b5);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td>&nbsp;</td>');
notesForm.document.write('<td>');
notesForm.document.write('&nbsp;',note10c);
notesForm.document.write('</td>');
notesForm.document.write('</tr>')

/* Write form for Note 11 */
notesForm.document.write('<tr><td align="top">&nbsp;</td>');
notesForm.document.write('<td>');
notesForm.document.write('&nbsp;',note11);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

```

Drawing Note Generator

Appendix

```
notesForm.document.write('<tr><td valign="top">&nbsp;</td>');
notesForm.document.write('<td>');
notesForm.document.write(notetab2, note11a1);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

/* Write form for Note 12 */
notesForm.document.write('<tr><td>&nbsp;</td>');
notesForm.document.write('<td>');
notesForm.document.write('&nbsp;',note12, '<br>');
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td      valign="top"><input      type="checkbox"      name="choice12a"
value="checkbox"></td>');
notesForm.document.write('<td>');
notesForm.document.write(notetab, 'A.&nbsp;',note12a1, '<br>');
notesForm.document.write(notetab2, note12a2, '<input type="text" name="var12a1" value = ".040" size =
"6">', note12a3);
notesForm.document.write(note12a3, '<input type="text" name="var12a2" value = "XX" size = "2">',
note12a4);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td      valign="top"><input      type="checkbox"      name="choice12b"
value="checkbox"></td>');
notesForm.document.write('<td>');
notesForm.document.write(notetab, 'B.&nbsp;',note12b, '<br>');
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td      valign="top"><input      type="checkbox"      name="choice12c"
value="checkbox"></td>');
notesForm.document.write('<td>');
notesForm.document.write(notetab, 'C.&nbsp;',note12c1);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td      valign="top"><input      type="checkbox"      name="choice12d"
value="checkbox"></td>');
notesForm.document.write('<td>');
notesForm.document.write(notetab, 'D.&nbsp;');
if (rigid) {
    notesForm.document.write(note12dr1);
}
else {
    notesForm.document.write(note12df1);
}
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

if (rf) {
    notesForm.document.write('<tr><td      valign="top"><input      type="Radio"      name="choice12e"
value="V1"></td>');
```

Drawing Note Generator Appendix

```

notesForm.document.write('<td>');
notesForm.document.write(notetab, 'E.&nbsp;',note12e1);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td align="top"><input type="Radio" name="choice12e"
value="V2"></td>');
notesForm.document.write('<td>');
notesForm.document.write(notetab, 'E',note12e2);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td align="top"><input type="checkbox" name="choice12f"
value="checkboxo"></td>');
notesForm.document.write('<td>');
notesForm.document.write(notetab, 'F.&nbsp;',note12f1);
notesForm.document.write('<select name="var12f1">');
notesForm.document.write('<option value="VAR12F1_1">VAR12F1_1</option>');
notesForm.document.write('<option value="VAR12F1_2" selected>VAR12F1_2</option>');
notesForm.document.write('<option value="VAR12F1_3">VAR12F1_3</option>');
notesForm.document.write('<option value="VAR12F1_4">VAR12F1_4</option>');
notesForm.document.write('<option value="VAR12F1_5">VAR12F1_5</option>');
notesForm.document.write('<option value="VAR12F1_6">VAR12F1_6</option>');
notesForm.document.write('</select>');
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td align="top"><input type="checkbox" name="choice12g"
value="checkbox"></td>');
notesForm.document.write('<td>');
notesForm.document.write(notetab, 'G.&nbsp;',note12g1);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');

notesForm.document.write('<tr><td align="top"><input type="checkbox" name="choice12h"
value="checkbox"></td>');
notesForm.document.write('<td>');
notesForm.document.write(notetab, 'H.&nbsp;',note12h1);
notesForm.document.write('<input name="var12h1" value="0.50" size="2">', notein_mm);
notesForm.document.write(note12h2);
notesForm.document.write('</td>');
notesForm.document.write('</tr>');
}

/* close table */
notesForm.document.write('</table>');

/* Pass values from noteGenerator to notegen.js program */

notesForm.document.write('<INPUT Type="hidden" NAME="notetab" VALUE = "",notetab,"">');

notesForm.document.write('<INPUT Type="hidden" NAME="tech" VALUE = "",technology,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="docFam" VALUE = "",docFam,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="IPCtest" VALUE = "",IPCtest,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="coupons" VALUE = "",coupons,"">');

```

Drawing Note Generator Appendix

```

notesForm.document.write('<INPUT Type="hidden" NAME="type" VALUE = "",type,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="ipcclass" VALUE = "",ipcclass,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="level" VALUE = "",level,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="plating" VALUE = "",plating,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="finish" VALUE = "",finish,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="use" VALUE = "",use,"">');
notesForm.document.write('<INPUT      Type="hidden"      NAME="MinSpaceInt"      VALUE      =
"",MinSpaceInt,"">');
notesForm.document.write('<INPUT      Type="hidden"      NAME="MinSpaceExt"      VALUE      =
"",MinSpaceExt,"">');
notesForm.document.write('<INPUT      Type="hidden"      NAME="eDataMinSpace"      VALUE      =
"",eDataMinSpace,"">');
notesForm.document.write('<INPUT      Type="hidden"      NAME="eDataMinWidth"      VALUE      =
"",eDataMinWidth,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="MRV" VALUE = "",MRV,"">');
notesForm.document.write('<INPUT      Type="hidden"      NAME="MaxDiaSolderHole"      VALUE      =
"",MaxDiaSolderHole,"">');

/* Pass notes from noteform to notegen */
notesForm.document.write('<INPUT Type="hidden" NAME="note0" VALUE = "", note0,"">');

notesForm.document.write('<INPUT Type="hidden" NAME="note1" VALUE = "", note1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note1a" VALUE = "", note1a,"">');

notesForm.document.write('<INPUT Type="hidden" NAME="note2" VALUE = "", note2,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note2a" VALUE = "", note2a,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note2a1" VALUE = "", note2a1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note2b" VALUE = "", note2b,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note2c" VALUE = "", note2c,"">');

notesForm.document.write('<INPUT Type="hidden" NAME="note3" VALUE = "", note3,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note3opt" VALUE = "", note3opt,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note3a" VALUE = "", note3a,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note3arf" VALUE = "", note3arf,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note3b" VALUE = "", note3b,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note3bplus" VALUE = "", note3bplus,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note3c" VALUE = "", note3c,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note3d" VALUE = "", note3d,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note3dplus" VALUE = "", note3dplus,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="notede" VALUE = "", notede,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="notederf1" VALUE = "", notederf1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="notederf2" VALUE = "", notederf2,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note3flam" VALUE = "", note3flam,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note3fnolam" VALUE = "", note3fnolam,
"">');
notesForm.document.write('<INPUT      Type="hidden"      NAME="note3fcompletelam"      VALUE      =
"",
note3fcompletelam, "">');
notesForm.document.write('<INPUT Type="hidden" NAME="note3g" VALUE = "", note3g,"">');

notesForm.document.write('<INPUT Type="hidden" NAME="note4" VALUE = "", note4,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note4plus" VALUE = "", note4plus,"">');

notesForm.document.write('<INPUT Type="hidden" NAME="note5" VALUE = "", note5,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note5plus" VALUE = "", note5plus,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note5opt" VALUE = "", note5opt,"">');

```

Drawing Note Generator

Appendix

```
notesForm.document.write('<INPUT Type="hidden" NAME="note6" VALUE = "", note6,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note6opt" VALUE = "", note6opt,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note6opt1" VALUE = "", note6opt1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note6rf" VALUE = "", note6rf,"">');
```

```
notesForm.document.write('<INPUT Type="hidden" NAME="note7" VALUE = "", note7,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note7a" VALUE = "", note7a,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note7b" VALUE = "", note7b,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note7c" VALUE = "", note7c,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note7d" VALUE = "", note7d,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note7e1" VALUE = "", note7e1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note7e2" VALUE = "", note7e2,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note7f" VALUE = "", note7f,"">');
```

```
notesForm.document.write('<INPUT Type="hidden" NAME="note8" VALUE = "", note8,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note8a" VALUE = "", note8a,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note8a1a" VALUE = "", note8a1a,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note8a1b" VALUE = "", note8a1b,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note8a2" VALUE = "", note8a2,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note8a3" VALUE = "", note8a3,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note8b1" VALUE = "", note8b1,"">');
```

```
notesForm.document.write('<INPUT Type="hidden" NAME="note9" VALUE = "", note9,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note9a1" VALUE = "", note9a1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note9a2" VALUE = "", note9a2,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note9b1" VALUE = "", note9b1,"">');
```

```
notesForm.document.write('<INPUT Type="hidden" NAME="note10" VALUE = "", note10,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10a1" VALUE = "", note10a1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10a2" VALUE = "", note10a2,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10a3" VALUE = "", note10a3,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10a4" VALUE = "", note10a4,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10a5" VALUE = "", note10a5,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10a6" VALUE = "", note10a6,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10a1opt" VALUE = "",
note10a1opt,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10a4opt" VALUE = "",
note10a4opt,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10a5opt" VALUE = "",
note10a5opt,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10aopt" VALUE = "", note10aopt,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10b1" VALUE = "", note10b1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10b2" VALUE = "", note10b2,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10b3" VALUE = "", note10b3,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10b4" VALUE = "", note10b4,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10b5" VALUE = "", note10b5,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note10c" VALUE = "", note10c,"">');
```

```
notesForm.document.write('<INPUT Type="hidden" NAME="note11" VALUE = "", note11,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note11a1" VALUE = "", note11a1,"">');
```

```
notesForm.document.write('<INPUT Type="hidden" NAME="note12" VALUE = "", note12,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note12a1" VALUE = "", note12a1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note12a2" VALUE = "", note12a2,"">');
```

Drawing Note Generator

Appendix

```
notesForm.document.write('<INPUT Type="hidden" NAME="note12a3" VALUE = "", note12a3,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note12a4" VALUE = "", note12a4,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note12b" VALUE = "", note12b,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note12c1" VALUE = "", note12c1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note12dr1" VALUE = "", note12dr1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note12df1" VALUE = "", note12df1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note12e1" VALUE = "", note12e1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note12e2" VALUE = "", note12e2,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note12f1" VALUE = "", note12f1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note12g1" VALUE = "", note12g1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note12h1" VALUE = "", note12h1,"">');
notesForm.document.write('<INPUT Type="hidden" NAME="note12h2" VALUE = "", note12h2,"">');

notesForm.document.write('<p><input type="button" value="Create Notes" onClick="makeNotes()">
<input type="reset" value="Reset" name="B2"></p>');
//notesForm.document.write('<font color="#FF0000"><B>Program is in alpha mode pressing [Create
Notes] button may not have desired results. </B>');
notesForm.document.write('</FORM></BODY></HTML>');

notesForm.document.close();
}
```

Drawing Note Generator Appendix

JavaScript Program – notegen.js

```
function format (expr, decplaces) {
  // raise incoming value by power of 10 times the
  // number of decimal places; round to an integer; convert to string
  var str = "" + Math.round (eval(expr) * Math.pow(10,decplaces))
  // pad small value strings with zeros to the left of rounded number
  while (str.length <= decplaces) {
    str = "0" + str
  }
  // establish location of decimal point
  var decpoint = str.length - decplaces
  // assemble final result from: (a) the string up to the position of
  // the decimal point; (b) the decimal point; and (c) the balance
  // of the string. Return finished product.
  return str.substring(0,decpoint) + "." + str.substring(decpoint,str.length);
}
```

```
function inch_um(inch){
  with (Math){
    um = inch*25400;
    umm = format(um,2);
  }
  return umm;
}
```

```
function inch_mm(inch){
  with (Math){
    mm = inch*25.4;
    mmm = format(mm,2);
  }
  return mmm;
}
```

```
function makeNotes(){  
  
var rigid = false;  
var rf = false;  
var flex = false;  
var debug = false;  
var notetab = "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&";  
var notetab2 = notetab + notetab;
```

```
/** Assignment of variables
if (document.fab.tech.value == "Rigid"){
    rigid = true;
    ipcdoc1 = "IPC-2221 AND IPC-2222";
    ipcdoc2 = "IPC-6012";
}
if (document.fab.tech.value == "Rigid/Flex"){
    rf = true;
    ipcdoc1 = "IPC-2221 AND IPC-2223";
    ipcdoc2 = "IPC-6012 OR IPC-6013";
}
```

Drawing Note Generator

Appendix

/** Note variable creation

```
notesWin = window.open("", "Notes",  
"menubar=yes,toolbar=yes,location=yes,scrollbars=yes,resizable=yes");
```

/** Write for debug

```
if (debug){  
    notesWin.document.write(document.fab.tech.value, ' Notes - Debug Mode <br>');  
    notesWin.document.write('<br>rigid = ', rigid, '<br>rf = ', rf, '<br>');  
    notesWin.document.write('Type: ', document.fab.type.value, '<br>');  
    notesWin.document.write('Class: ', document.fab.ipcclass.value, '<br>');  
    notesWin.document.write('Level: ', document.fab.level.value, '<br>');  
    notesWin.document.write('Plating: ', document.fab.plating.value, '<br>');  
    notesWin.document.write('Finish: ', document.fab.finish.value, '<br>');  
  
    if (rf){  
        notesWin.document.write('Use: ', document.fab.use.value, '<br>');  
    }  
  
    notesWin.document.write('docFam: ', document.fab.docFam.value, '<br>');  
    notesWin.document.write('IPCtest: ', document.fab.IPCtest.value, '<br>');  
    notesWin.document.write('Coupon: ', document.fab.coupons.value, '<br>');  
    notesWin.document.write('Min Conductor Space Internal: ', document.fab.MinSpaceInt.value, '<br>Min  
Conductor Space Internal: ', document.fab.MinSpaceExt.value, '<br>eData Min Space: ',  
document.fab.eDataMinSpace.value, '<br>');  
    notesWin.document.write('eData Min Width: ', document.fab.eDataMinWidth.value, '<br>');  
    notesWin.document.write('Min Rated Voltage: ', document.fab.MRV.value, '<br>');  
    notesWin.document.write('Maximum diameter for solder filled holes: ',  
document.fab.MaxDiaSolderHole.value, '<br>');  
    notesWin.document.write('Serialization controlled item: ', document.fab.controlled.value, '<br>');  
    notesWin.document.write('problem note = ', document.fab.note8a5a.value, '<br>');  
    notesWin.document.write('<br><b>Last line of debug</b><br>');  
  
    notesWin.document.write('<hr>');  
}
```

/** Write notes to document

```
if (debug){notesWin.document.write('Note 0 <br>');}  
  
notesWin.document.write(document.fab.note0.value, '<br>');  
  
/* Note 1 */  
if (debug){notesWin.document.write('Note 1 <br>');}  
notesWin.document.write(document.fab.note1.value, '<br>');  
  
notesWin.document.write(document.fab.note1a.value, '<br>');  
  
if(document.fab.var1extra.value != ""){  
    note1b = notetab  
        + document.fab.var1extra.value;  
    notesWin.document.write(note1b + 'br>');  
}
```

Drawing Note Generator Appendix

```
/* Note 2 */
if (debug){notesWin.document.write('Note 2 <br>');}
notesWin.document.write(document.fab.note2.value, '<br>');

notesWin.document.write(document.fab.note2a.value, '<br>');
notesWin.document.write(document.fab.note2a1.value, '<br>');
notesWin.document.write(document.fab.note2b.value, '<br>');
notesWin.document.write(document.fab.note2c.value, '<br>');

/* Note 3 */
if (debug){notesWin.document.write('Note 3 <br>');}
notesWin.document.write(document.fab.note3.value, '<br>');

if (rigid && document.fab.choice3opt.checked){
    notesWin.document.write(document.fab.note3opt.value, '<br>');
}

note3a = document.fab.note3a.value
    + document.fab.var3a[document.fab.var3a.selectedIndex].value;

if (rigid) {
    note3aw = note3a
        + '<br>';
    if (document.fab.option3a.value) {
        note3aw = note3a
            + "<br>TYPE "
            + document.fab.option3a.value
            + '<br>';
    }
}

else {
    note3aw = note3a
        + '<br>'
        + document.fab.note3arf.value
        + '<br>';
}

notesWin.document.write(note3a, '<br>');

if (rigid){
    note3b = document.fab.note3b.value
        + document.fab.slash3b[document.fab.slash3b.selectedIndex].value
        + "&nbsp;"
        + document.fab.note3bplus.value
        + "&nbsp;"
        + document.fab.qualclass3b[document.fab.qualclass3b.selectedIndex].value
        + '<br>';
}
else {
    note3b = document.fab.note3b.value
        + '<br>';
}
notesWin.document.write(note3b);
```

Drawing Note Generator

Appendix

```
notesWin.document.write(document.fab.note3c.value,'<br>');

if (rf){
    note3d = notetab
        + "D. "
        + document.fab.note3d.value
        + document.fab.slash3d[document.fab.slash3d.selectedIndex].value
        + "&nbsp;"
        + document.fab.note3dplus.value
        + "&nbsp;"
        + document.fab.qualclass3d[document.fab.qualclass3d.selectedIndex].value
        + "<br>";

    note3e = "E. "
        + document.fab.notede.value
        + "&nbsp;"
        + document.fab.min_dielectric_space_rf.value
        + "&nbsp;"
        + "INCH ("
        + inch_um(document.fab.min_dielectric_space_rf.value)
        + " MICROMETERS)"
        + document.fab.min_dielectric_space.value
        + "INCH ("
        + inch_um(document.fab.min_dielectric_space.value)
        + " MICROMETERS)"
        + "<br>";

    note3f = "F. "
        + document.fab.note3flam.value
        + "&nbsp;"
        + document.fab.note3flamx.value
        + " THTOUGH "
        + document.fab.note3flamy.value
        + "&nbsp;"
        + document.fab.note3fnolam.value
        + "&nbsp;"
        + document.fab.note3fnolamx.value
        + " AND "
        + document.fab.note3fnolamy.value
        + " LAYERS "
        + document.fab.note3fcompletelamx.value
        + " THROUGH "
        + document.fab.note3fcompletelamy.value
        + document.fab.note3fcompletelam.value
        + "<br>";
}
else {
    note3d = "D. "
        + document.fab.notede.value
        + "&nbsp;"
        + document.fab.min_dielectric_space.value
        + "INCH ("
        + inch_um(document.fab.min_dielectric_space.value)
        + " MICROMETERS)"
}
```

Drawing Note Generator Appendix

```

        + "<br>";
    }

    if(rf){
        notesWin.document.write(note3d);
        notesWin.document.write(note3e,'<br>');
        notesWin.document.write(note3f,'<br>');
    }

    else{
        notesWin.document.write(notetab, note3d);
    }
}

if (rf){
    if (document.fab.choice3gopt.checked){
        note3g = document.fab.note3g.value
            + document.fab.note3gextra.value
            + "<br>";
        notesWin.document.write(note3g);
    }
}

/* Note 4 */
if (debug){notesWin.document.write('Note 4 <br>');}
note4 = document.fab.note4.value
    + "<br>"
        + notetab2
        + notetab
    + document.fab.MinSpaceInt.value
    + " INCH ("
    + inch_mm(document.fab.MinSpaceInt.value)
    + " MM) - INTERNAL"
    + "<br>"
        + notetab2
        + notetab
    + document.fab.MinSpaceExt.value
    + " INCH ("
    + inch_mm(document.fab.MinSpaceExt.value)
    + " MM) - EXTERNAL"
    + "<br>"
    + document.fab.note4plus.value
    + document.fab.eDataMinSpace.value
    + " INCH ("
    + inch_mm(document.fab.eDataMinSpace.value)
    + " MM).";
notesWin.document.write(note4 + '<br>');

/* Note 5 */
if (debug){notesWin.document.write('Note 5 <br>');}
note5 = document.fab.note5.value
    + "<br>"
        + notetab2
        + notetab
    + document.fab.internal_conduct_width.value
    + " INCH ("
    + inch_mm(document.fab.internal_conduct_width.value)
    + " MM) - INTERNAL"

```

Drawing Note Generator Appendix

```
+ "<br>"
    + notetab2
    + notetab
+ document.fab.external_conduct_width.value
+ " INCH ("
+ inch_mm(document.fab.external_conduct_width.value)
+ " MM) - EXTERNAL"
+ "<br>"
+ document.fab.note5plus.value
+ document.fab.eDataMinWidth.value
+ " INCH ("
+ inch_mm(document.fab.eDataMinWidth.value)
+ " MM.).";
notesWin.document.write(note5 + '<br>');

/* Note 6 */
if (debug){notesWin.document.write('Note 6 <br>');}
if (document.fab.choice6opt[0].checked){
note6 = document.fab.note6.value;
}

if (document.fab.choice6opt[1].checked){
    note6 = document.fab.note6.value
    + document.fab.note6opt.value
    + document.fab.pointa.value
    + " AND "
    + document.fab.pointb.value
    + document.fab.note6opt1.value
    + document.fab.MRVopt.value
    + " VOLTS.";
}

if (rf){
    note6 = note6
    + document.fab.note6rf.value;
}

notesWin.document.write(note6 + '<br>');

/* Note 7 */
if (debug){notesWin.document.write('Note 7 <br>');}
note7 = document.fab.note7.value;
note7a = document.fab.note7a.value;
note7b = document.fab.note7b.value;
note7c = document.fab.note7c.value;
note7d = document.fab.note7d.value;
note7e = document.fab.note7e1.value
    + document.fab.MaxDiaSolderHole.value
    + " INCH ("
    + inch_mm(document.fab.MaxDiaSolderHole.value)
    + " MM) "
    + document.fab.note7e2.value;
note7f = document.fab.note7f.value;

notesWin.document.write(note7 + '<br>');
```

Drawing Note Generator Appendix

```
notesWin.document.write(note7a + '<br>');
notesWin.document.write(note7b + '<br>');
notesWin.document.write(note7c + '<br>');
notesWin.document.write(note7d + '<br>');
notesWin.document.write(note7e + '<br>');
if (rf){
    notesWin.document.write(note7f + '<br>');
}

/* Note 8 */
if (debug){notesWin.document.write('Note 8 <br>');}
note8 = ""
    + document.fab.note8.value;
notesWin.document.write(note8 + '<br>');

note8a = ""
    + document.fab.note8a.value;

if (document.fab.choice8a[1].checked){
    note8a = ""
        + document.fab.note8a1a.value
        + document.fab.var8a1a.value
        + " INCH ("
        + inch_um(document.fab.var8a1a.value)
        + " MICROMETERS) "
        + document.fab.note8a1b.value
        + ". ";
}
if (document.fab.choice8a[2].checked){
    note8a = document.fab.note8a2.value;
}
if (document.fab.choice8a[3].checked){
    note8a = document.fab.note8a3.value;
}

notesWin.document.write(note8a + '<br>');

if (document.fab.choice8b.checked){
    note8b = document.fab.note8b1.value
        + document.fab.var8a1.value
        + "INCH ("
        + inch_um(document.fab.var8a1.value)
        + " MICROMETER)";
    notesWin.document.write(note8b + '<br>');
}

/* Note 9 */
if (debug){notesWin.document.write('Note 9 <br>');}
note9 = document.fab.note9.value;
notesWin.document.write(note9 + '<br>');

note9a = document.fab.note9a1.value
    + document.fab.var9a1.value
```

Drawing Note Generator Appendix

```
+ document.fab.note9a2.value;
notesWin.document.write(note9a+ '<br>');

if (document.fab.choice9b.checked){
    note9b = document.fab.note9b1.value;
    notesWin.document.write(note9b + '<br>');
}

/* Note 10 */
if (debug){notesWin.document.write('Note 10 <br>');}
note10 = document.fab.note10.value;
notesWin.document.write(note10 + '<br>');

if(document.fab.choice10a[0].checked){
    note10a = document.fab.note10a1.value;
    if (document.fab.choice10aopt1.checked){
        note10a = note10a
            + document.fab.note10a1opt.value;
    }

    note10a = note10a
        + document.fab.note10a2.value
        + document.fab.var10a1.value
        + document.fab.note10a3.value
        + document.fab.var10a2.value
        + document.fab.note10a4.value;
    if (document.fab.choice10aopt4.checked){
        note10a = note10a
            + document.fab.note10a4opt.value;
    }

    note10a = note10a
        + document.fab.note10a5.value;
    if (document.fab.choice10aopt5.checked){
        note10a = note10a
            + document.fab.note10a5opt.value;
    }

    note10a = note10a
        + document.fab.note10a6.value;
    }
else {
    note10a = document.fab.note10aopt.value;
}
notesWin.document.write(note10a + '<br>');

note10b = document.fab.note10b1.value
    + document.fab.var10b1.value
    + document.fab.note10b2.value
    + document.fab.var10b2.value
    + document.fab.note10b3.value
    + document.fab.var10b3.value
    + document.fab.note10b4.value
    + document.fab.var10b4.value
    + document.fab.note10b5.value;
notesWin.document.write(note10b + '<br>');

if (document.fab.controlled){
```

Drawing Note Generator Appendix

```
note10c = document.fab.note10c.value;
notesWin.document.write(note10c + '<br>');
}

/* Note 11 */
if (debug){notesWin.document.write('Note 11<br>');}

note11 = document.fab.note11.value;
notesWin.document.write(note11 + '<br>');

note11a = document.fab.note11a1.value;
notesWin.document.write(notetab + note11a + '<br>');

/* Note 12 */
if (debug){notesWin.document.write('Note 12 <br>');}

if (document.fab.choice12a.checked || document.fab.choice12b.checked || document.fab.choice12c.checked
|| document.fab.choice12d.checked){
    note12 = document.fab.note12.value;
    notesWin.document.write(note12 + '<br>');
    note_letter = new Array(10)
    var note_space = "&nbsp;";
    var cnt = 0;
    note_letter[0] = "A.";
    note_letter[1] = "B.";
    note_letter[2] = "C.";
    note_letter[3] = "D.";
    note_letter[4] = "E.";
    note_letter[5] = "F.";
    note_letter[6] = "G.";
    note_letter[7] = "H.";
    note_letter[8] = "I.";
    note_letter[9] = "J.";

    if(document.fab.choice12a.checked){
        note12a = document.fab.note12a1.value
        + document.fab.note12a2.value
        + document.fab.var12a1.value
        + ' INCH ('
        + inch_mm(document.fab.var12a1.value)
        + ' MM)'
        + document.fab.note12a3.value
        + document.fab.var12a2.value
        + document.fab.note12a4.value;
        notesWin.document.write(notetab + note_letter[cnt] + note_space + note12a + '<br>');
        cnt++;
    }

    if(document.fab.choice12b.checked){
        note12b = document.fab.note12b.value;
        notesWin.document.write(notetab + note_letter[cnt] + note_space + note12b + '<br>');
        cnt++;
    }
}
```

Drawing Note Generator

Appendix

```

        if(document.fab.choice12c.checked){
            note12c = document.fab.note12c1.value;
            notesWin.document.write(notetab + note_letter[cnt] + note_space + note12c + '<br>');
cnt++;
        }

        if(document.fab.choice12d.checked){
            if(rigid){
                note12da = document.fab.note12dr1.value;
            }
            else {
                note12da = document.fab.note12df1.value;
            }

            notesWin.document.write(notetab + note_letter[cnt] + note_space + note12da + '<br>');
cnt++;
        }
        if (rf) {
            if (document.fab.choice12e[0].checked || document.fab.choice12e[1].checked ||
document.fab.choice12f.checked || document.fab.choice12g.checked || document.fab.choice12h.checked){

                if(document.fab.choice12e[0].checked){
                    note12e = document.fab.note12e1.value;
                    notesWin.document.write(notetab + note_letter[cnt] + note_space +
note12e + '<br>');

                    cnt++;
                }
                else {
                    note12e = document.fab.note12e2.value;
                    notesWin.document.write(notetab + note_letter[cnt] + note_space +
note12e + '<br>');

                    cnt++;
                }

                if(document.fab.choice12f.checked){
                    note12f = document.fab.note12f1.value;
                    notesWin.document.write(notetab + note_letter[cnt] + note_space +
note12f + '<br>');

                    cnt++;
                }

                if(document.fab.choice12g.checked){
                    note12g = document.fab.note12g1.value;
                    notesWin.document.write(notetab + note_letter[cnt] + note_space +
note12g + '<br>');

                    cnt++;
                }

                if(document.fab.choice12h.checked){
                    note12h = document.fab.note12h1.value
                        + document.fab.note12h2.value;
                    notesWin.document.write(notetab + note_letter[cnt] + note_space +
note12h + '<br>');

                    cnt++;
                }
            }
        }
    
```

Drawing Note Generator Appendix

```
        }  
    }  
  
}  
  
/* Close document */  
notesWin.document.close();  
}
```



Engineering Process Improvement

LOCKHEED MARTIN



Drawing Note Generator

Karen McConnell, CID
Harry Finocchiaro
Scott Park

Karen McConnell – Senior Member Engineering Staff
Engineering Process Improvement Center
Lockheed Martin Corporation
3 Executive Campus
4th Floor, Suite 420
Cherry Hill, NJ 08002
Phone: (856) 792-9417
Fax: (856) 792-9455
Email: karen.e.mcconnell@lmco.com



Agenda

- Development process
- Problems with reusing notes
- First attempt (Note Generator – V2)
- Current generator
- Brief demonstration
- Future enhancements

Development Process

- **Develop a common set of notes to be used across the corporation**
- **Allow for the variety of products**
- **The real time generation of notes forces the designer to verify that all requirements were flowed down**
- **Work with your fabricators when developing your notes**
 - Create notes that are flexible and can be used by multiple fabricators
 - Incorporate the enhancements, changes and corrections from the fabricators
- **Provide a program to assist with the implementation of the standard notes**
- **Generate “fresh” notes for each board**

Problems with Reusing Notes

● Minimum space 1

- Minimum spacing requirement: 5-mil spacing
- Note sets minimum space to 8-mil spacing.
- AOI machine stops at all the 5-mil spaces and marks them as failures
- Cost: time delay as errors are reviewed and the note is corrected.

● Minimum spacing 2

- Minimum spacing requirement: 8-mil spacing
- Note sets minimum space to 6-mil spacing.
- AOI passes a 6-mil segment
- Cost: board and design are scraped

***Possibility of introducing errors when
Designers manually change note data.***

● Voltage problem

- Power board with an operating voltage of 220 volts.
- Drawing note set this at 50 volts
- Error traced to a missing requirement flow down process
- Problem: Board was tested at 100 volts instead of 500 volts
- Cost: unknown because failure is not predictable

Errors cost time and money. They effect the quality of the design.

PWB Fabrication Note Generator

Version 2.2

- Rigid Notes
- Rigid/Flex Notes
- Flex Notes

Create Note Form

Reset

Note: If a new screen does not appear, please refresh your page using the refresh icon  or use the pull down menu View>Refresh or use the F5 function key.

Rigid Note Generator

Version 2.1

Color Codes:

Red indicates variable values to be filled in

Note: Red text from the document has been replaced by pull down lists and dialog boxes.

Red text in the web document denotes place holders for values calculated by the script.

Blue indicates optional wording

Green indicates references to help determine proper noteselection. Do not include in actual drawing note. Variables and info herein are LMC recommendations and are not intended to be all inclusive.

NOTES: UNLESS OTHERWISE SPECIFIED:

1. INTERPRET THIS DRAWING IN ACCORDANCE WITH (IAW) THE FOLLOWING STANDARDS/SPECIFICATIONS:

A. IPC-D-325. (DRAWING)

B. ANSI/ASME Y14.5M, 1994. (DIMENSIONS)

C. IPC-2221 AND IPC-2222 TYPE - Multilayer Board without blind or buried via .

CLASS - High Reliability Electronic Products .

LEVEL - Moderate Design Complexity - Standard (DESIGN)

D. ANSI/IPC-T-50 (TERMS AND DEFINITIONS)

E. Any others as required

(Use CAPS to enter -- start each line with alpha beginning with "E."

(For a carriage return in the final document at a "
" - do not use quote marks.

2. QUALIFICATION AND PERFORMANCE REQUIREMENTS:

* A. IPC-6011 CLASS - High Reliability Electronic Products .

IPC-6012 TYPE - Multilayer Board without blind or buried via .

PLATING PROCESS - Acid copper electroplating only .

FINAL FINISH - Electrodeposited Tin-Lead, (fused) .

If you leave off 6012 Class, Plating Process and Final Finish refer to IPC-6012 for defaults.

- Primitive version of the Note Generator
 - Program duplicated each note
 - No checking of dependant information
 - A brute force automation of the typing the notes
 - No checking for consistency
- As long as the notes did not change, the program was okay.*

Rigid Note Generator

Version 2.1

Color Codes:

Red indicates variable values to be filled in

Note: Red text from the document has been replaced by pull down lists and dialog boxes.

Red text in the web document denotes place holders for values calculated by the script.

Blue indicates optional wording

Green indicates references to help determine proper noteselection. Do not include in actual drawing note.

Variables and info herein are LMC recommendations and are not intended to be all inclusive.

NOTES: UNLESS OTHERWISE SPECIFIED:

1. INTERPRET THIS DRAWING IN ACCORDANCE WITH STANDARDS/SPECIFICATIONS:

A. IPC-D-325. (DRAWING)

B. ANSI/ASME Y14.5M, 1994. (DIMENSIONS)

C. IPC-2221 AND IPC-2222 TYPE 3 - Multilayer Board w

CLASS 3 - High Reliability Electronic Products

LEVEL B - Moderate Design Complexity - Standard

D. ANSI/IPC-T-50 (TERMS AND DEFINITIONS)

E. Any others as required

(Use CAPS to enter -- start each line with alpha begin

(For a carriage return in the final document at a "
"

2. QUALIFICATION AND PERFORMANCE REQUIREMENTS:

A. IPC-6011 CLASS 3 - High Reliability Electronic Products

IPC-6012 TYPE 3 - Multilayer Board without blind or buried v

PLATING PROCESS 1 - Acid copper electroplating only

FINAL FINISH T - Electrodeposited Tin-Lead, (fused)

If you leave off 6012 Class, Plating Process and Final

NOTES: UNLESS OTHERWISE SPECIFIED

1. INTERPRET THIS DRAWING IN ACCORDANCE WITH (IAW) THE FOLLOWING STANDARDS/SPECIFICATIONS:

A. IPC-D-325 (DRAWING)

B. ANSI/ASME Y14.5M, 1994 (DIMENSIONS)

C. IPC-2221 AND IPC-2222 TYPE 3, CLASS 3, LEVEL B.(DESIGN)

D. ANSI/IPC-T-50 (TERMS AND CONDITIONS)

2. QUALIFICATION AND PERFORMANCE REQUIREMENTS:

A. IPC-6011 CLASS 3, IPC-6012 TYPE 3, PLATING PROCESS 1, FINAL FINISH T.

B. NO IPC-6012 SPECIAL REQUIREMENTS TESTING REQUIRED.

C. SUPPLIED TEST COUPON IS IAW IPC-2221.

D. THE PRINTED WIRING BOARD SHALL MEET THE REQUIREMENTS OF THE REVISION IN EFFECT AT THE TIME OF PROCUREMENT.

3. MATERIAL REQUIREMENTS:

MANUFACTURER SHALL SELECT MATERIALS TO ACHIEVE A BALANCED CONSTRUCTION AND TO MEET THE REQUIREMENTS SPECIFIED HEREIN, INCLUDING DIMENSIONAL REQUIREMENTS IN STACKUP VIEW.

A. LAMINATE AND PREPREG MATERIALS PER IPC-4101/21 .

B. COPPER FOIL SHALL BE IN ACCORDANCE WITH IPC-4562/1, QUALITY CLASSIFICATION .

C. THE MINIMUM NUMBER OF REINFORCING LAYERS BETWEEN ADJACENT CONDUCTIVE LAYERS SHALL BE TWO.

D. THE MINIMUM DIELECTRIC SPACING SHALL BE 0.0035 INCH (88.90 MICROMETERS).

Note Generator (V3)

EPI PWB Fabrication Note Generator

Version - IPC APEXPO - Designer's Summit 2004

Technology

☒ Rigid Notes ☐ Rigid/Flex Notes

Requirements & Qualifications Specs:

☒ IPC 6010 (Series designation for IPC-6011, 6012, & 6013)

Plating Process

Final Finish ☒ (Either Type S or T) - Preferred by our suppliers

Type

Class

Level

Use

☐ Lockheed Martin 00000000 (Cage Code: #####)

☐ LM#### (Site specific document for fabrication)

Board Information

Does this board require IPC Special Testing? ☐ Yes ☒ No
(Testing can drive cost and lead-time)

Design includes test coupons? ☐ Yes ☒ No

The dimensional requirements will be presented in a stackup

Internal minimum conductor spacing: Inch

External minimum conductor spacing: Inch

Electronic Data Minimum Conductor Spacing: Inch

Electronic Data Minimum Conductor Width: Inch

Maximum diameter for solder filled holes:

Maximum Rated Voltage: Volts

- Update of standard notes caused a rewrite of both programs
- Start form enhanced to capture multiple use variables such as USE, CLASS, and TYPE.
- Note text defined in one program
- Note format defined once
- JavaScript Single program update if not as my previous..

Rigid Note Generator

Version 3.0

Color Codes:

~~Red indicates variable values to be filled in~~

Note: Red text from the document has been replaced by pull down lists and dialog boxes.

Red text in the web document denotes place holders for values calculated by the script.

Blue indicates optional wording

Green indicates references to help determine proper noteselection. Do not include in actual drawing note.

Variables and info herein are LMC recommendations and are not intended to be all inclusive.

NOTES: UNLESS OTHERWISE SPECIFIED:	
1.	INTERPRET THIS DRAWING IN ACCORDANCE WITH (IAW) THE FOLLOWING STANDARDS/SPECIFICATIONS:
	A. IPC-2221 AND IPC-2222 TYPE ,3, CLASS 2, LEVEL B. (DESIGN)
	B. Any others as required (Use CAPS to enter -- start each line with alpha beginning with "B." (For a carriage return in the final document at a " " - do not use quote marks.
2.	QUALIFICATION AND PERFORMANCE REQUIREMENTS:
	A. IPC-6011 AND IPC-6012 TYPE ,3, CLASS 2, PLATING PROCESS 1, FINAL FINISH X. - THE PRINTED WIRING BOARD SHALL MEET THE REQUIREMENTS OF THE REVISION IN EFFECT AT THE TIME OF PROCUREMENT.
	B. NO IPC-6012 SPECIAL REQUIREMENTS TESTING REQUIRED.
	C. THIS DESIGN DOES NOT INCLUDE QUALITY CONFORMANCE COUPONS. MANUFACTURER SHALL INCORPORATE REPRESENTATIVE COUPONS IAW IPC-2221 AND/OR USE PRODUCTION BOARDS FOR QUALITY CONFORMANCE INSPECTIONS.
3.	MATERIAL REQUIREMENTS:
	MANUFACTURER SHALL SELECT MATERIALS TO ACHIEVE A BALANCED CONSTRUCTION AND TO MEET THE REQUIREMENTS SPECIFIED HEREIN, INCLUDING DIMENSIONAL REQUIREMENTS IN VIEW.
○	THE SPACING BETWEEN EACH CONDUCTOR LAYER SHALL BE EVENLY DISTRIBUTED THROUGH THE TOTAL FINISHED THICKNESS, WITH EACH INDIVIDUAL DIELECTRIC SPACING BEING WITHIN 25% OF THE AVERAGE DIELECTRIC SPACING OF THE BOARD.
	A. LAMINATE AND PREPREG MATERIALS PER IPC-4101/21 (Optionally add TYPE , i.e. GFN, GIN, etc.).

NOTES: UNLESS OTHERWISE SPECIFIED:

1. INTERPRET THIS DRAWING IN ACCORDANCE WITH (IAW) THE FOLLOWING STANDARDS/SPECIFICATIONS:
 - A. IPC-2221 AND IPC-2222 TYPE ,3, CLASS 2, LEVEL B. (DESIGN)
2. QUALIFICATION AND PERFORMANCE REQUIREMENTS:
 - A. IPC-6011 AND IPC-6012 TYPE ,3, CLASS 2, PLATING PROCESS 1, FINAL FINISH X.
- THE PRINTED WIRING BOARD SHALL MEET THE REQUIREMENTS OF THE REVISION IN EFFECT AT THE TIME OF PROCUREMENT.
 - B. NO IPC-6012 SPECIAL REQUIREMENTS TESTING REQUIRED
 - C. THIS DESIGN DOES NOT INCLUDE QUALITY CONFORMANCE COUPONS.
MANUFACTURER SHALL INCORPORATE REPRESENTATIVE COUPONS IAW IPC-2221 AND/OR USE PRODUCTION BOARDS FOR QUALITY CONFORMANCE INSPECTIONS
3. MATERIAL REQUIREMENTS:
MANUFACTURER SHALL SELECT MATERIALS TO ACHIEVE A BALANCED CONSTRUCTION AND TO MEET THE REQUIREMENTS SPECIFIED HEREIN, INCLUDING DIMENSIONAL REQUIREMENTS IN VIEW.
 - A. LAMINATE AND PREPREG MATERIALS PER IPC-4101/21
 - B. COPPER FOIL SHALL BE IN ACCORDANCE WITH IPC-4562/1 , QUALITY CLASSIFICATION 1.
 - C. THE MINIMUM NUMBER OF REINFORCING LAYERS BETWEEN ADJACENT CONDUCTIVE LAYERS SHALL BE TWO.
 - D. THE MINIMUM DIELECTRIC SPACING SHALL BE .0035INCH (88.90 MICROMETERS).



Engineering Process Improvement

LOCKHEED MARTIN



Demonstration



and the DESIGNERS SUMMIT

Future Direction

- **Current implementation of the PWB Fabrication Note Generator is hard coded data**
- **Next generation of the PWB Fabrication Note Generator currently in development**
 - Aimed at eliminating some of the constraints of the hard coded design.
 - Content management and design flexibility
 - entire user interface will be web based
 - Note changes can be added with no programming skills.
- **Database driven design enables a more versatile range of functions such as formatting**
- **Gain the benefit with the reduction of data redundancy**

- Notes are used throughout the tool without reentry
- Server side lifts browser constraints
- Note creator stores HTML elements alongside plain text while dynamically extracting form values upon user input
- Construction of the end user interface remains similar to the current version
- New applications may be created without recoding



Engineering Process Improvement

LOCKHEED MARTIN



Questions

