MARTIN COMPANY
Electronics Engineering and Manufacturing

Design Reviews

Why, Who, When and How?

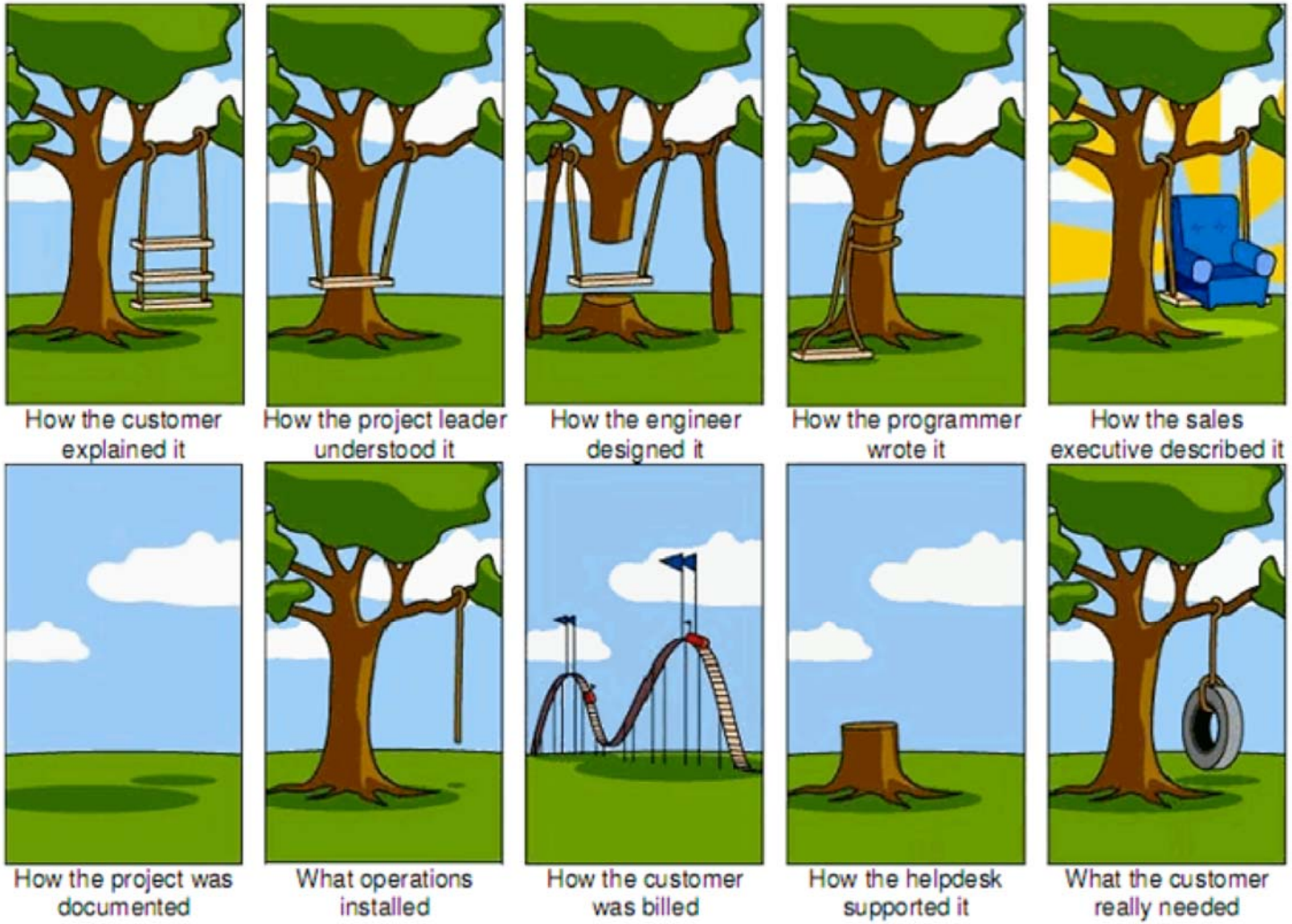
John Martin

18 May 2016

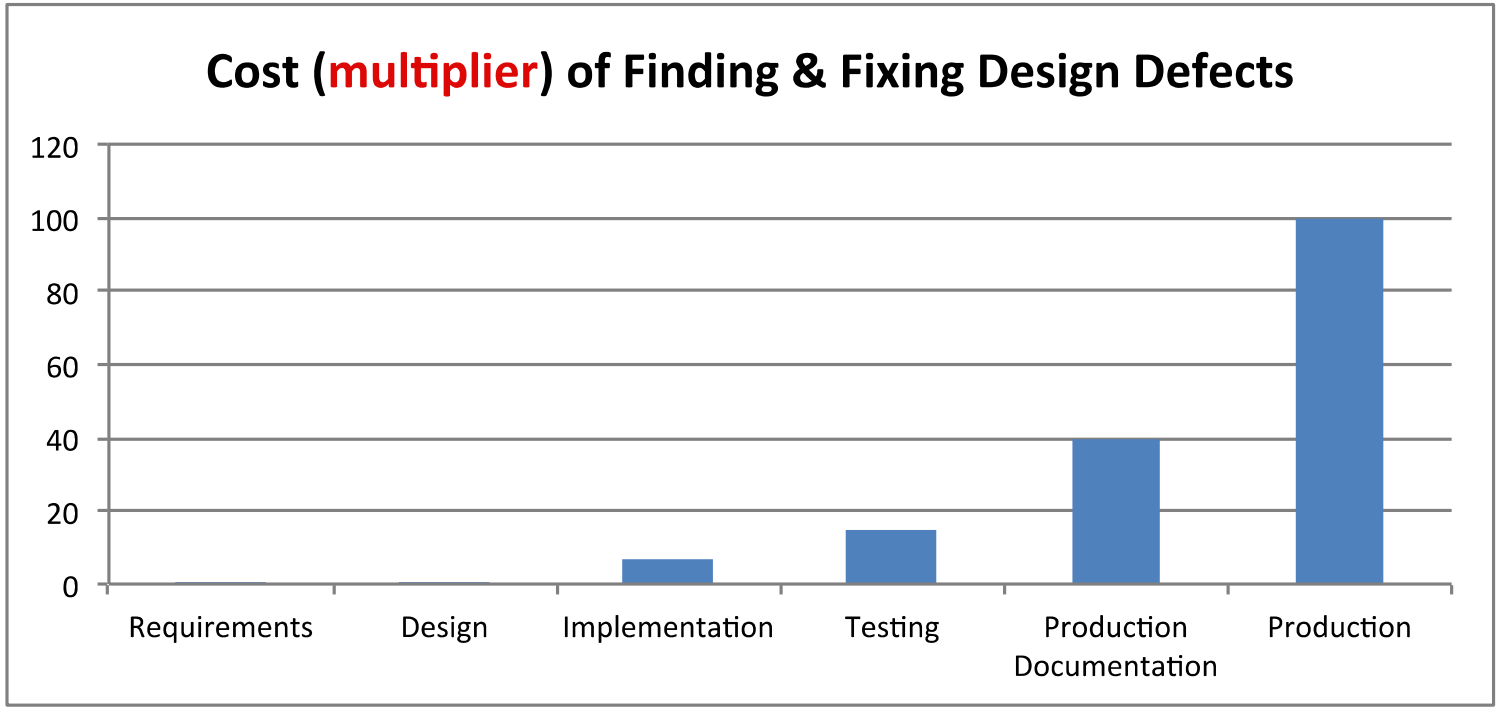
Reviews are Everywhere

- Oil and Gas
  - BP's Macondo Well
- Medical
  - Review of treatment protocols
- Legal
  - Law makers review/debate legislation
- Management
  - Daily, Weekly, Monthly

We All Understand the Swing?



Cost versus Time

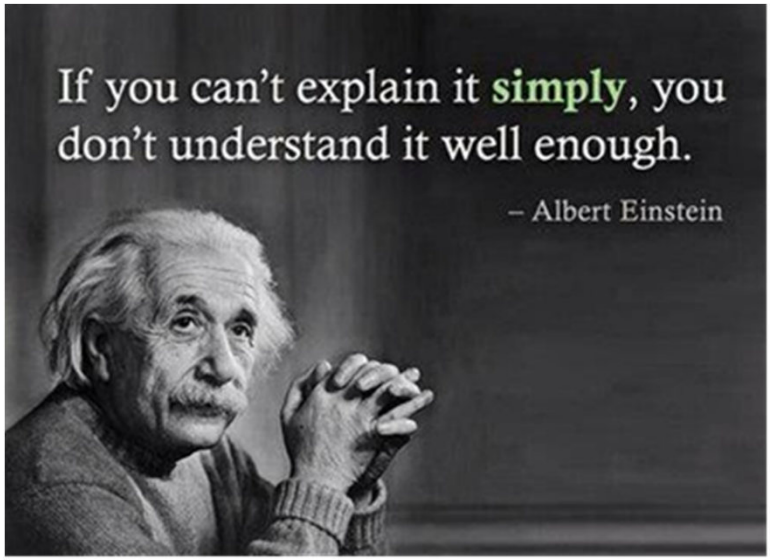


Early discovery of the real customer needs and consistent communication to the team assures a lower cost and better quality design project.

Reasons for Reviews

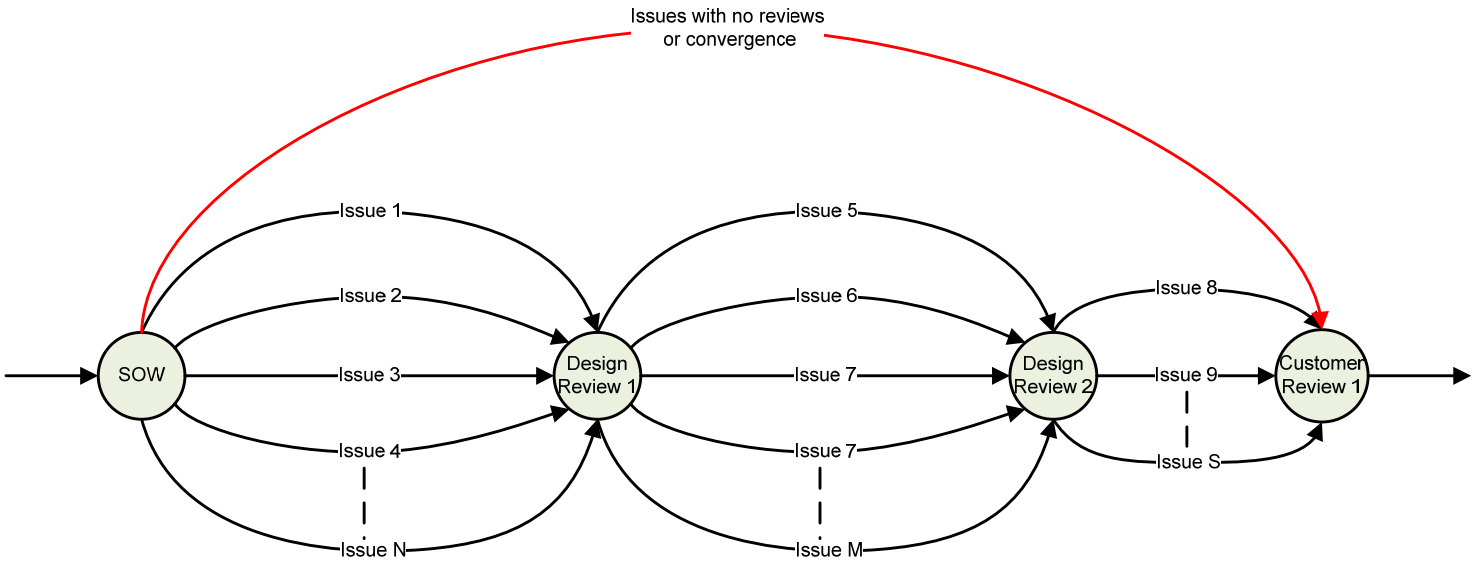
- Business Reasons
  - Quality emphasis
  - Ethical responsibility
  - Professionalism
  - Liability
  - Think like owning the business
- Human Resource Reasons
  - Basic management practices
  - Identify development needs
  - Mutual accountability
- Engineering Reasons
  - Sharing of best practices
  - Improved project management

Reviews Improve Quality



Design reviews prepare us to present a similar review to the customer. Internal and customer reviews greatly improve the quality of design projects.

Convergence of Issues at Reviews



Reviews provide milestones for the development process that improve project management. Issues include Technical & Schedule & Budget.

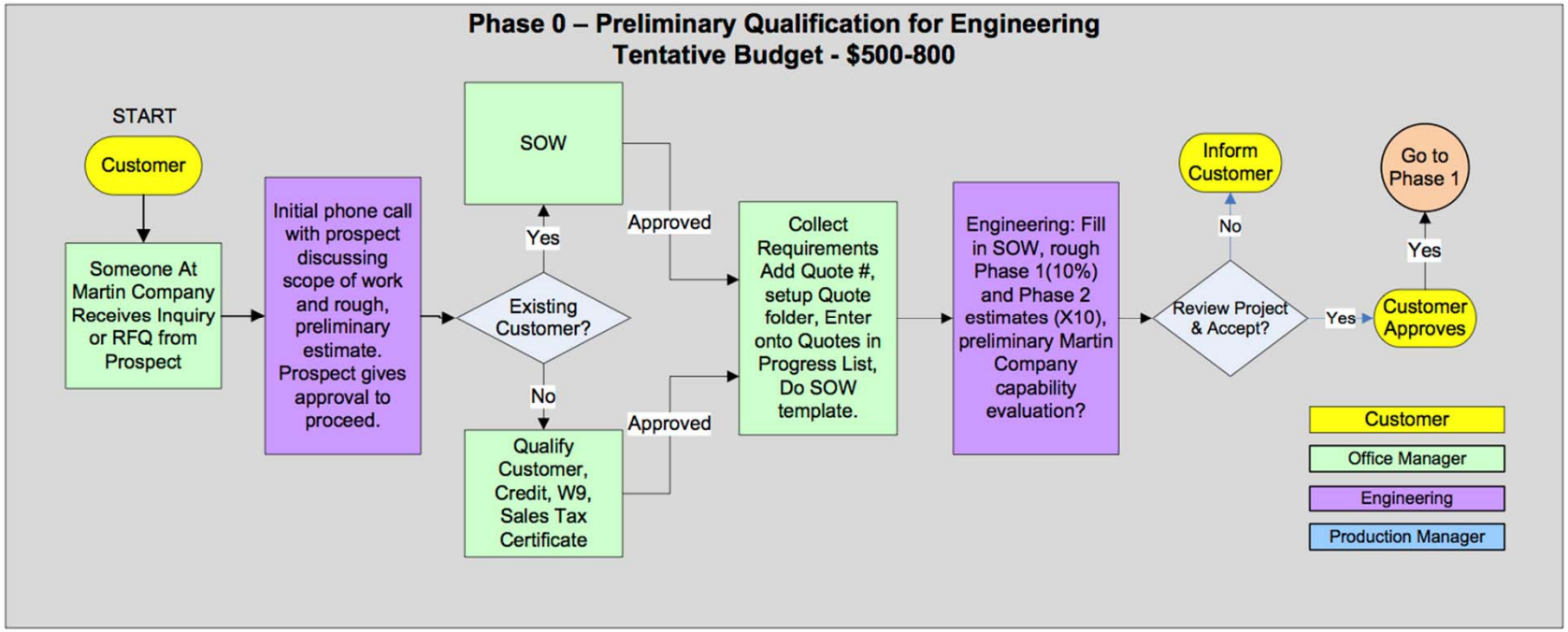
Two Heads are better than One

Linus's Law states that "given enough eyeballs, all bugs are shallow"; or more formally: "Given a large enough beta-tester and co-developer base, almost every problem will be characterized quickly and the fix will be obvious to someone." Created by Linus Torvalds - Linux Kernel Chief Architect

Martin Company

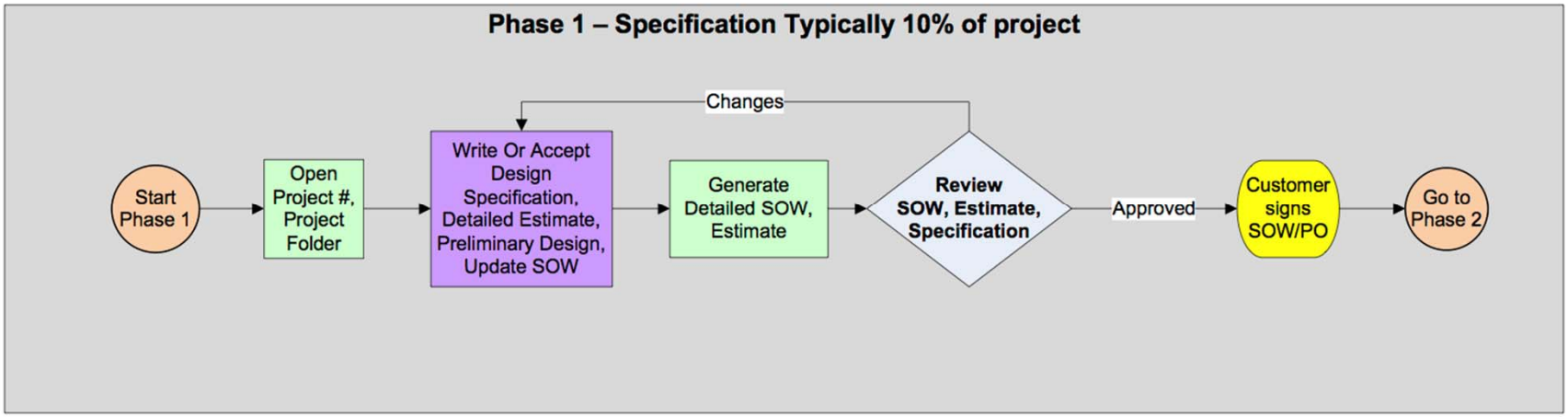
Our goal is that we **review 100%** of the work that we do. All design, eCAD and engineering projects will plan for, estimate, sell and explain to the customer the need for and document design reviews. We review the Design Review folders on all projects on a regular basis to verify the existence of proper reviews. Our personnel reviews, the ISO-9001 quality management system and the management of Martin Company **require** documented reviews to do their jobs properly.

New Project Review



- BY: Office manager or accountant, project manager, president
- FOCUS: Credit information, Preliminary SOW and Estimate, Resource loading

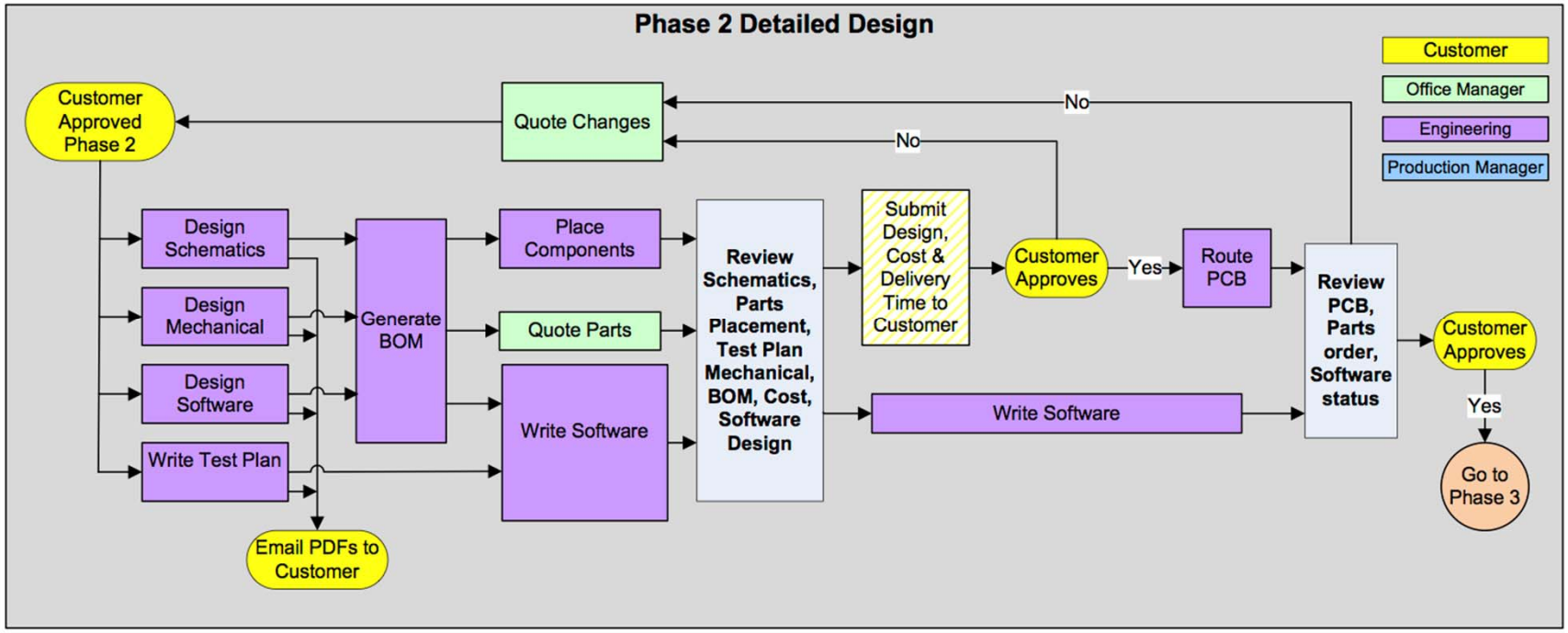
Project Specification Review



3	Testing	136	9				145	$9,968			14 Nov '14	13 Jan '15	
3.1	Creating test procedure	16	2				18	$1,248			14 Nov '14	21 Nov '14	
3.2	Simulation testing	80	4				84	$5,760			14 Nov '14	19 Dec '14	
3.3	Hardware testing	40	3				43	$2,960			14 Nov '14	2 Dec '14	
4	Design Review	4	2	2			8	$682			14 Nov '14	17 Nov '14	
5	Project Managment			2	2	2	6	$434			14 Nov '14	14 Nov '14	

- BY: Project Members, invite Customer
- FOCUS: SOW, Estimate, Specifications

Detailed Design Review



- BY: Project Members, invite Customer
- FOCUS: SOW, Project Status, Specification, Change List, Schematics, Parts Placement on PCB, Mechanical Design, Software Design, Test Plan

Customer Design Update Email

From: John Sent: Fri 8/9/2013 11:17
To: David; Charles
Cc: Gary; Greg; John
Subject: 2112 - PCB check-plots and RS485 interface ground pad issue
Message AS800005 (PCB check-plots - MODBUS LV MOD Rev XA).pdf (3 MB) AS800005 (preliminary Rev XA) - 28JAN15.PDF (1 MB)
Change List.txt (5 KB)

David,

Here are the updated PCB check-plots. Please review them and let us know if there are any issues.

The PCB is on the ASF template and all the DRC issues have been resolved. If it looks OK, we'll do our final design review (you're welcome to attend), and then we can generate the CAM files.

We're also attaching (again) the schematics, but they still need to transferred to the current ASF template (and be renamed AS800005).

One final issue – I'm attaching a change list that Charles had in the project directory – it mentions something about adding a mounting hole? That would be a fairly large effort (you can see there really isn't room for one – given the top/bottom components, and the test points that cannot be moved). The only space I can see on the board might be at the top-right were the board number is in top-copper, however a mounting hole at corner of the board doesn't seem stable. Is this a requirement?

Thank you

John Keker
jwk@martincomp.com
MARTIN COMPANY
Electronics Engineering and Manufacturing
ISO 9001:2008 Certified
281-342-7431
www.martincomp.com

Template Reviews Phase 2

Engineering Revision Control.doc

General Description

Customer Name:	Northern Woods Electronics	**Project Number**	2112
Project Name:	ASF board		

Project Documentation Name List

Document Type	Original Document Name/Revision:	Date	Appr by:
Design Specification	**ASF Initial Specification.pdf (David)**	**29Oct08**	**JM**
Protel	**AS800005 (ASF Master LV Rev NR).ddb**	**18 Mar 13**	**CP**
Mechanical Drawings			
Assembly Drawings	**AS800005 (ASF Master LV Rev A) - Assembly**	**06 Jun 13**	**JK**
Firmware			
Test Plan			

Note that this is a new board (with new name & NWE #) but is basically a revision of the original ASF Master Board (AS800005 - Rev G) board.

Revision History (from AS800005 - Rev G)

#	Revision Date:	Description of Revision and Reason for Revision:	Rev. by:	Appr. by:
Schematic Revision NR				
1.	18 Mar 13	Change Q2 FET to a T0-252 version (metal can type failed the pressure test).	JK	CP
2.	18 Mar 13	Change resistors around Q2 FET (to match turn/off of original part).	JK	CP
3.	18 Mar 13	Change Current Sense and Balancing resistors to molded plastic types (ceramic types can crack over temperature & pressure).	JK	CP
4.	18 Mar 13	Add test connector (P1) (per David's request)	JK	CP
5.		Add redundant RS485 connections to J5 (per David's request)	JK	CP
PCB Layout Revision NR				
6.	18 Mar 13	Change Q2 FET to a T0-252 version.	JK	CP
7.	18 Mar 13	Add redundant RS485 connections to J5.	JK	CP
8.	18 Mar 13	Add redundant RS485 connections to J6.	JK	CP
Schematic Revision 01				
9.	06 Jun 13	Change R22 and R23 to 24.9K	CP	JK
Schematic Revision 02				
10.	29 Aug 13	Add Female connector part @ P1 (per Jim Blake's request)	JK	CP
11.	29 Aug 13	Remove ANEG from GND and connect AGND to GND (allows correct sensing of current during low power.)	JK	CP
12.	29 Aug 13	Add 10uF caps to the inputs of U8 & U11 (prevent accidental resets & enables).	JK	CP
PCB Layout Revision A				
13.	06 Jun 13	Revision changed from NR to A	CP	JK
PCB Layout Revision B				
14.	29 Aug 13	Adjust footprint of P1 (to accept Harwin # B52-5000123 connector).	JK	CP
15.	29 Aug 13	Remove ANEG from GND and connect AGND to GND.	JK	CP
16.	29 Aug 13	Fix footprint on NI1026 dual FET's (using mfg's recommended footprint).	JK	CP
17.	29 Aug 13	Add 3 test points (67, 68 & 69) for FET measurement on automated tester.	JK	CP
Assembly Revision B				
18.	21 Oct 13	Changed schematic revision block to, "Rev B"	CP	JK
19.	21 Oct 13	Changed assembly file revision block to, "Rev B"	CP	JK
20.	21 Oct 13	Changed BOM to reference Rev B pick-and-place	CP	JK
21.	21 Oct 13	Changed BOM to reference Rev B schematic	CP	JK
22.	21 Oct 13	Changed BOM to reference Rev B assembly	CP	JK
PCB and Assembly Revision C				
23.	07 Mar 14	Removed erroneous paste mask from bottom layer POGO pins	CP	JK
24.	07 Mar 14	Added test points 70 and 71 for POGO pin connection to NFET drain and source	CP	JK
25.	07 Mar 14	Slightly moved R7, R103, and F1 so that the new test point would fit	CP	JK
26.	07 Mar 14	Modified new BOM assemblies so that they call out the correct part revisions	CP	JK

Initial (Rev N/R) Design Review

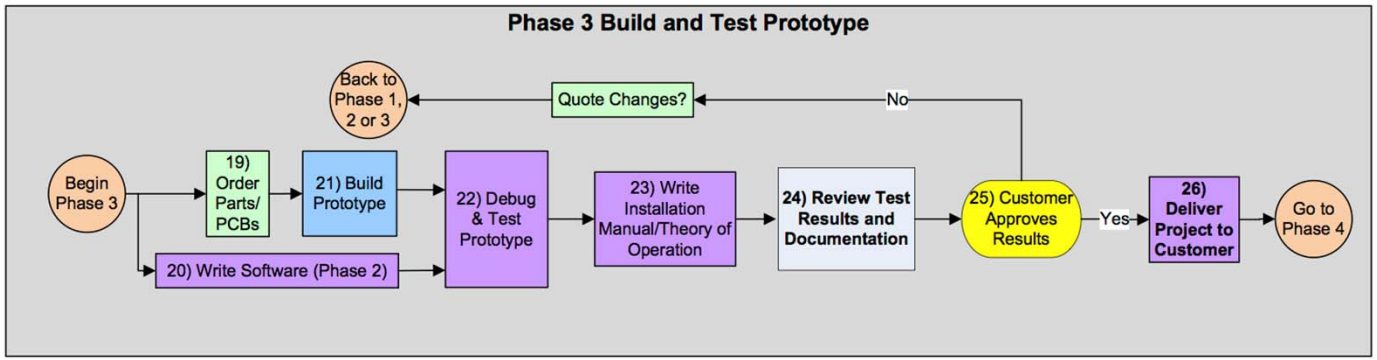
Design Review Attendees	Documents, Revision # Reviewed:	Document Date	Date	Appr by:
JM, CP, GP, JK	AS800005 (ASF Master LV Rev NR) - Schematic.pdf	25 Mar 13	25 Mar 13	**CP**
JM, CP, GP, JK	AS800005 (ASF Master LV Rev NR) - PCB Checkplots.pdf	25 Mar 13	25 Mar 13	**CP**
JM, CP, GP, JK	AS800005 (ASF Master LV Rev NR) - Gerber Plots.pdf	25 Mar 13	25 Mar 13	**CP**
JM, CP, GP, JK	AS800005 (ASF Master LV Rev NR) - Pastemask.zip	25 Mar 13	25 Mar 13	**CP**
JM, CP, GP, JK	AS800005 (ASF Master LV Rev NR) - CAM Files.zip	25 Mar 13	25 Mar 13	**CP**

Rev 01 Design Review

Design Review Attendees	Documents, Revision # Reviewed:	Document Date	Date	Appr by:
CP, JK	AS800005 (ASF Master LV Rev 01).ddb	05 Jun 13	06 Jun 13	JK
CP, JK	AS800005 (ASF Master LV Rev 01) - Schematic.pdf	05 Jun 13	06 Jun 13	JK
CP, JK	AS800005 (ASF Master LV Rev NR) - Pick-and-Place.zip	05 Jun 13	06 Jun 13	JK
CP, JK	AS800005 (5 SERIES Master LV Rev NR) - BOM.xls	05 Jun 13	06 Jun 13	JK

Engineering Revision Control.doc Version 1.0 by JM on 16 October 2007

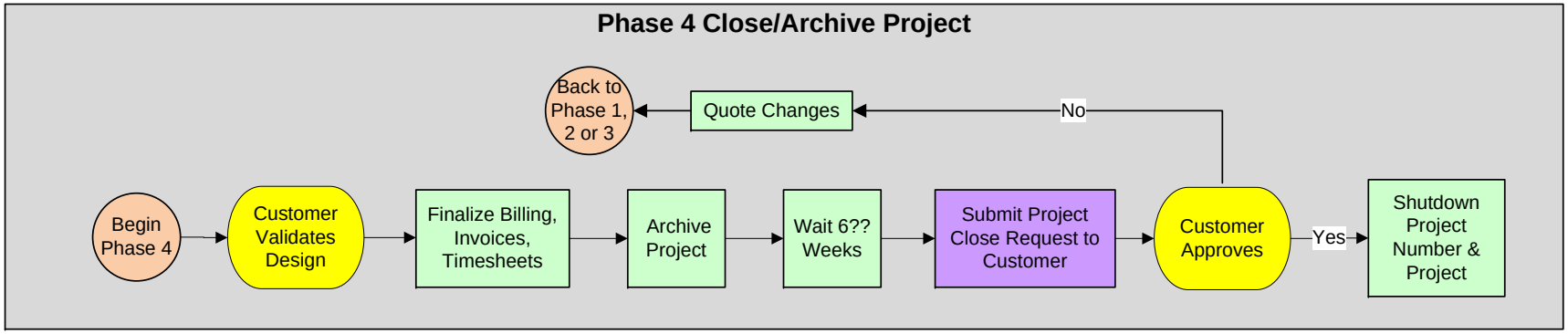
Test Results and Release



#	Revision Date:	Description of Revision and Reason for Revision:	Rev. by:	Appr. by:
Design Specification Revision XX				
1.				
Test Procedure Rev Revision XX				
1.				
Test Results Rev Revision XX				
1.				

- BY: Project Members, invite Customer
- FOCUS: SOW, Project Status, Specification, Change List, Schematics, PCB, Mechanical Design, Software Design, Test Results
- ALSO: Gerbers, Manufacturing Files, CM42 or Production BOM

Template Review Close Out Phase 4



Final Documentation Review

Design Review Attendees	Documents, Revision # Reviewed:	Document Date	Review Date	Appr by:

Project Close and Archive

Customer Contacted	Customer Comments	Date	Review Date	Appr by:
Project Close	**Comments**	**Date**	**Review Date**	**Appr by:**

Engineering Revision Control.doc Version 1.0 by JM on 16 October 2007

- BY: Project Members
- FOCUS: Final document package, customer feedback, project close

09 Design Review Folders

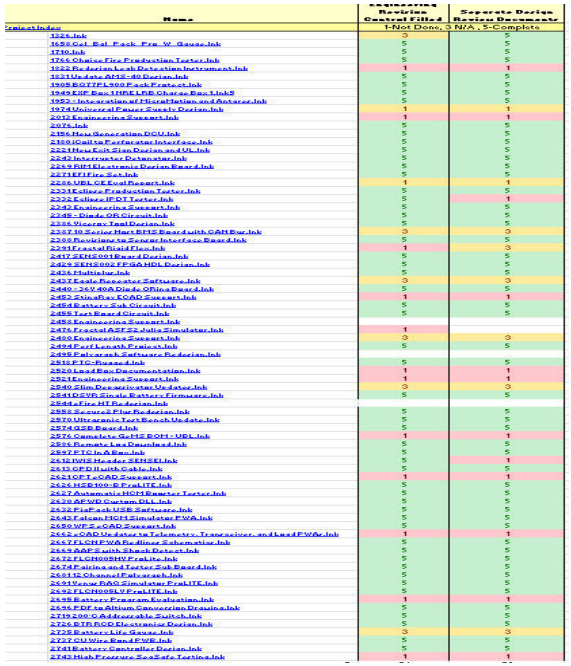
- Black and white SOW.pdf
- Black and white Estimate.pdf
- Black and white Project Status.pdf
- Black and white Change List or Engineering Control Document.pdf
- Color Specification. Pdf
- Color Schematics.pdf
- Color Parts Placement.pdf
- Color PCB Layout.pdf
- Color Software Design Diagrams.pdf
- Color Code Review.pdf
- Black and white BOM from Altium.pdf
- Black and white Mechanical Drawings.pdf
- Black and white Assembly Drawings.pdf
- Color Test Plan and Test Results.pdf
- Black and White Gerbers.pdf
- Black and White Manufacturing Files.pdf
- Black and White CM42 or Production BOM from GeMS.pdf

Requirements for a Good Review

- Careful Preparation
- Timely Submittal of Documents to Participants
  - Two working days ahead of time
- Good Meeting Practices
  - Agenda, Time Keeping, Minutes, Table Topics, Template
  - Summary and Objective
  - Respectful Culture
- Guided Discussion
  - Focus on critical, controversial, difficult
- Focus: Happy Customers = Repeat Customers

Status of Review Practices

- **Numerical Score:**



Project Reviews	Engineering Revision Control Filled Out	Separate Design Review Documents
Done	54	53
Not Done	14	14
Not Started	6	6
Total	74	73

- **Some Conclusions**:
- We have some projects that are successful with no documented reviews and some that were highly reviewed but considered “difficult” projects.
- We have to follow accepted, best practices and protocols in order to maintain consistent quality and manage projects and people.

Final Words

- **Every Project:** Our goal is to do documented design reviews on all design projects unless there is a signed waiver in place of the design review.
- **Training:** We will provide training so that our engineers can explain to the customer the benefit and cost saving of design reviews.