The benefits of working with Reliability Solutions

Martin Shaw – Reliability Solutions
www.reliabilitysolutions.co.uk

Reliability Solutions – Background

Biography

Martin Shaw (BSc Hons), Reliability Solutions

18 Hillside, Houston, PA6 7NT, Scotland, UK

Reliability Solutions focuses on providing the complete range of Reliability Improvement tools and Application Solutions to Significantly Reduce your product failure levels at the most expensive end of the product cycle, the Consumer

Reliability Solutions was formed in 1997 by Martin Shaw, previously of IBM as Quality and Reliability Specialist within PC business unit. Martin Shaw worked as specialist in Product and Commodity Quality / Reliability optimisation for the Electronic Product Suppliers to IBM between the years of 1982-1997. During this time he worked extensively throughout Asia, USA and Europe with wide range of suppliers. Since 1997 he has worked with a wide range of companies Worldwide and provided solutions to ensure RAPID improvement in a dynamic environment. These companies include many Blue-Chip companies: Daewoo Electronics, LiteOn, Astec Power, Philips, TPV, Vestel, Acer, LiteOn Power, LG, Amtran, Fairchild Semiconductors, Atmel Semiconductors, Wolfson Microelectronics, Analog Devices, GE, ULTRA Electronics, Melexis, IDEAL Heating, SKY TV, Hua Wei, Emerson Power, EE Phones, TCL, SMART Technology, Singapore Technology Kinetics, Etc.

He provides a range of 2-3 day Reliability Improvement Seminars and Application consultancy to meet the exact needs of any Electronic Manufacturer. He can be contacted at

www.reliabilitysolutions.co.uk

reliabilitysolutions@yahoo.co.uk

Background

- In today's business you simply CANNOT separate Reliability from all other areas of product and process development
- Reliability Engineers can no longer rely on old standards such as Mil-Std 217 or using software packages only to estimate possible future failure levels
- Using old fashioned standard High Temp Accelerated Life Testing (ALT) simply does not stimulate the types of complex weaknesses found in modern product designs with wireless connection, battery support, multi processors, etc
- As consumer electronic products have become more complex and are regarded as throw away type items, the need to understand and measure reliability has become CRITICAL to SUCCESS and PROFIT
- A new approach is ESSENTIAL

Introduction

- Form 30 yrs experience in working with numerous clients, Reliability Solutions have developed the most effective ‘Holistic’ approach to achieving WORLD CLASS Reliability

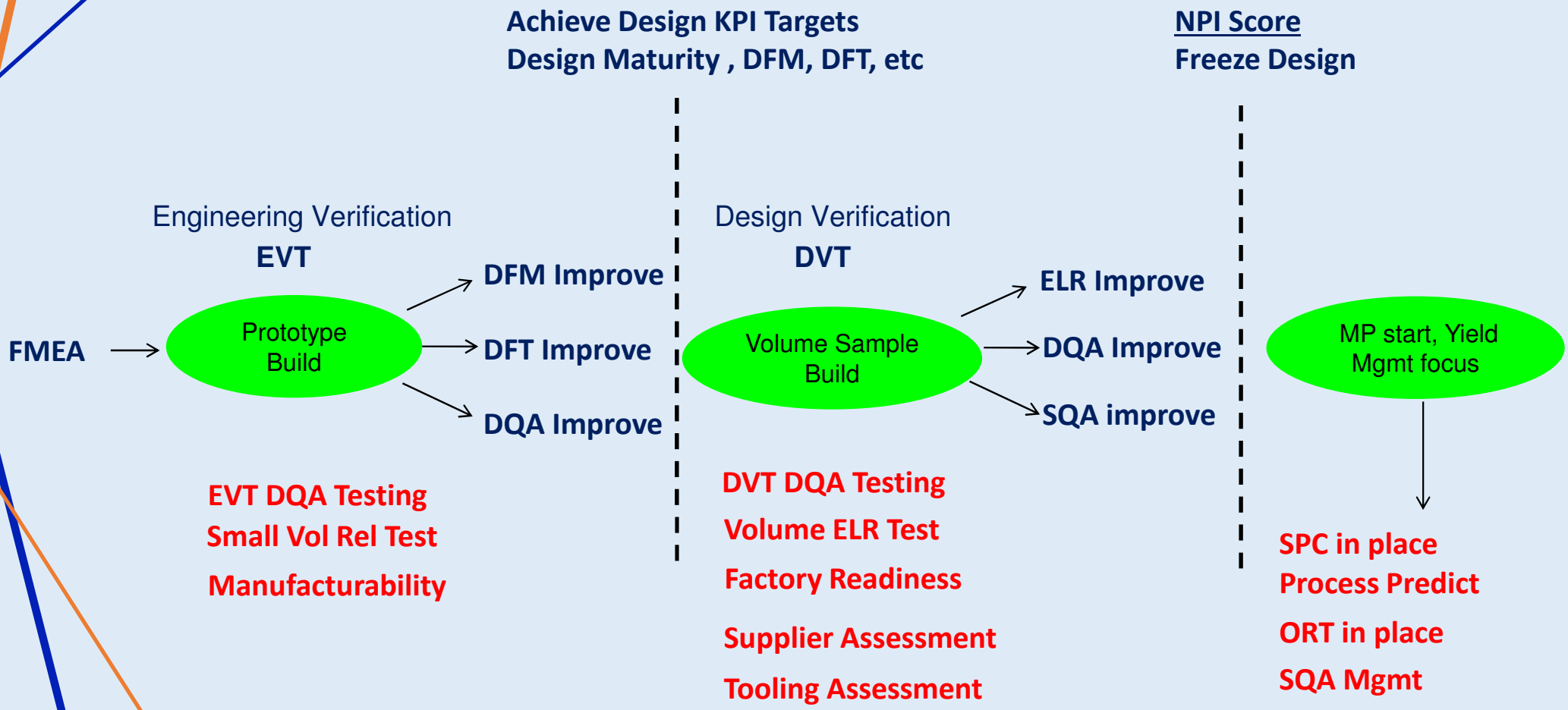
- 7 key improvement **Focus Items** are used which bring highest level of return in defect reduction;

  1. Design Quality Assurance Test (DQA) with % DESIGN MATURITY Measurement as an R&D KPI
  2. Supplier Quality Assurance (SQA) management with Early Life Reliability prediction from process performance measurements
  3. Focus on Sub-System Accelerated Stress Testing
  4. Tailored Accelerated Reliability Stress Test Methods (Early Life and Long Life) to maximise Defect Detection for maximising effect of ALT
  5. Strong DFM , DFT Programmes
  6. DFMEA methods made specific to the product type, ensuring DFMEA is made ‘real’ and NOT a tick in box approach
  7. New Product Introduction (NPI) Control / Management Process with unique measurement scoring

- Working in a systematic manner with simultaneous focus on all 7 areas will MAXIMISE production yield, efficiency AND Reliability

- In today’s business you simply CANNOT separate Reliability from all other areas of product and process development, chart below emphasis this clearly

THE HOLISTIC WAY AHEAD



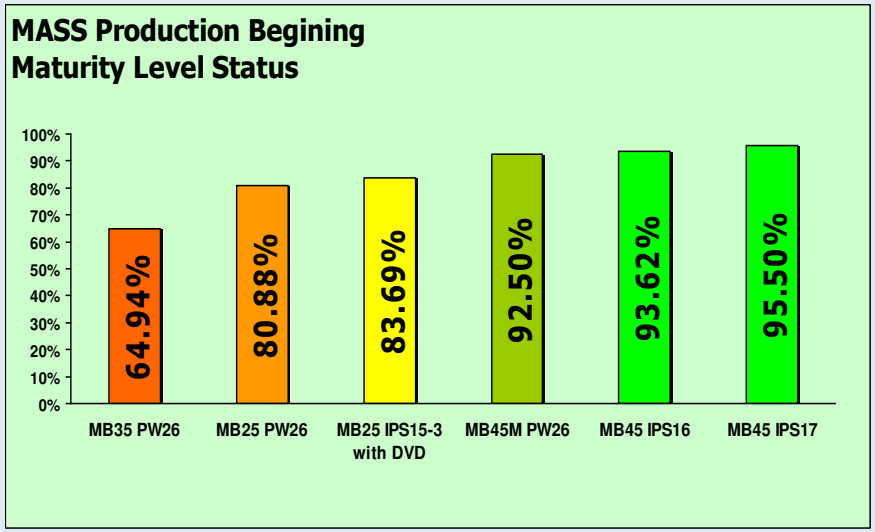
How is it Done ?

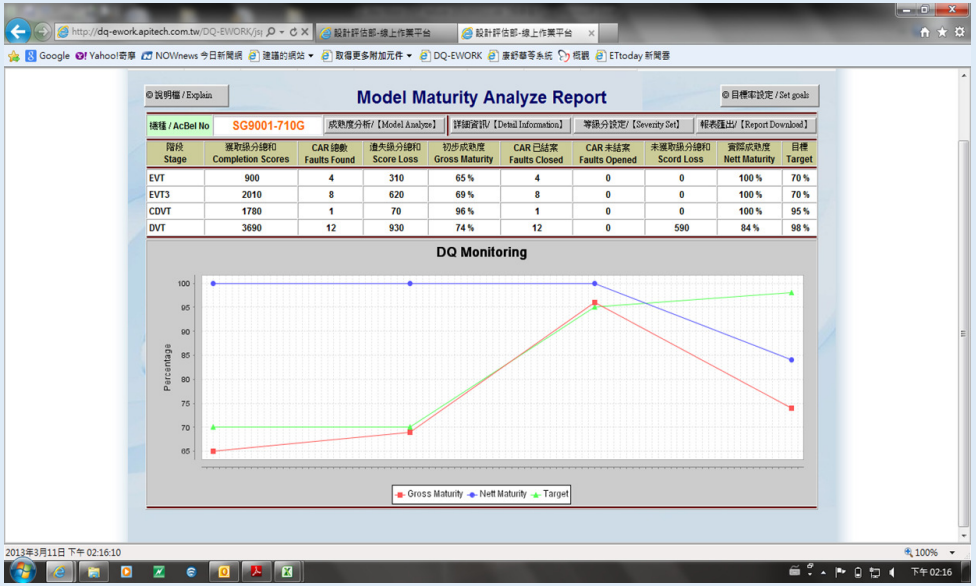
- Apply STRONG test programmes with MEASUREMENTS which can be used to asses future product reliability
- Set up key measurements which all contribute to future product failure levels , though none individually may correlate directly
  - % DQA Design Maturity
  - DFA / DFT % score based on detailed methodology and scoring
  - Sample Early Life Reliability Test output from unique Early Life Test approach per product type
  - Factory manufacturing readiness score
  - Key Supplier Assessment scoring
  - Process Early Life failure prediction models in place
  - ALT output / fail rate prediction
  - Prototype DFMEA scoring with overall scoring based on potential issue grading
- Develop the overall model (NPI model) to take all measurements and combine in a suitable statistical manner to provide a single output score that relates to feild failure levels of new products

DQA Test / Design Maturity Measurement

- DQA Test Methodology is very important in finding the Major Issues BEFORE Mass Production
- Without a Strong and Organised DQA Test programme, too many major issues will escape to field in Early MP and will only get resolved after field feedback, 6-9 mths following shipment
  - Improvement in line with aggressive improvement targets will NOT be achieved
- A Strong DQA Test Programme with Design Maturity Controls allows the producer to control release of new design and make Objective decisions based on % Design Maturity level
  - Low Maturity means poor production yield and high Early Life Failure Rate based on correlation with customer data
- GAP analysis of company R & D Testing will highlight what improvements required, then weighted scoring for each test activity is used for Maturity Measurement to drive ongoing RD Improvement
- Each time a defect is found there is a score loss from total score of all testing and a ratio of Design Maturity is then calculated
- % Design Maturity is a CLEAR and EFFECTIVE way to measure and benchmark Design Quality

DQA Test / Design Maturity Measurement





Predicting Early Life Fail Rates from Manufacturing Process data

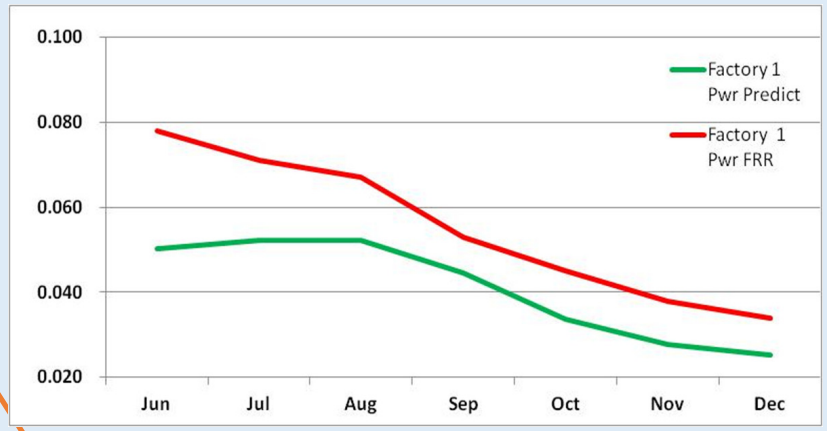
- Applying the appropriate model and correlating with Field Data shows how Process Yield data can be used to predict Field Fail Levels from M.P
  - Developed for Electronic Sub-Systems in LCD TV, equally appropriate to other products
  - Example of approach taken to show Power Board Prediction from Process data
  - Develop correlation model to take Rolled yield and predict Early Life Failure rate, example;
    - ((1-(R9^((1-0.838)/0.838)))*100), **R9 – Rolled Yield**

Key Process Step	2009	2010	2011
Pwr Board PCBA ICT	0.969	0.986	0.988
Pwr Board PCBA Func Test	0.996	0.997	0.997
Pwr Board FA Yield	0.996	0.997	0.997
Pwr Board Overall ROLLED	0.961	0.980	0.982
PWR Board FIELD Escape (%)	0.76	0.39	0.35

Predicting Early Life Fail Rates from Manufacturing Process data

- With dedicated study of data and field failure data, good correlation can be achieved between predicted failure levels and actual reported FRR (field return rates) from field

Product Level

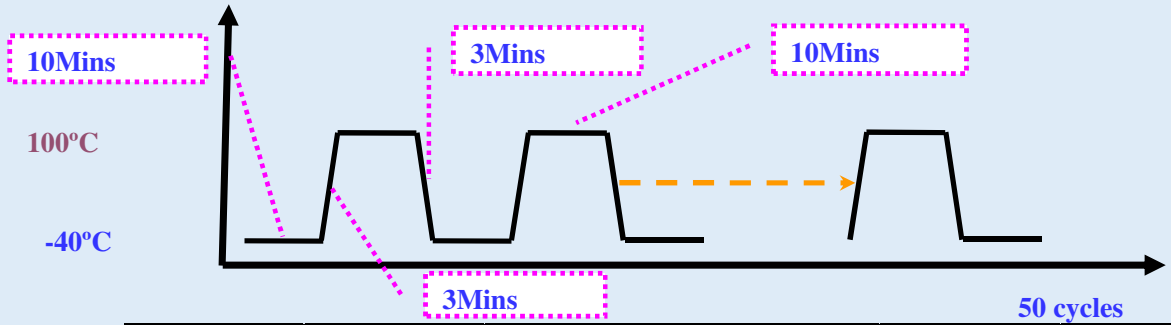


Sub-Assy Level

Sub System Accelerated Stress Testing

- Too many companies stick with same old product level stress test methods to try and simulate field issues rather than stimulating any new potential defect types, End result is MANY defect types are MISSED

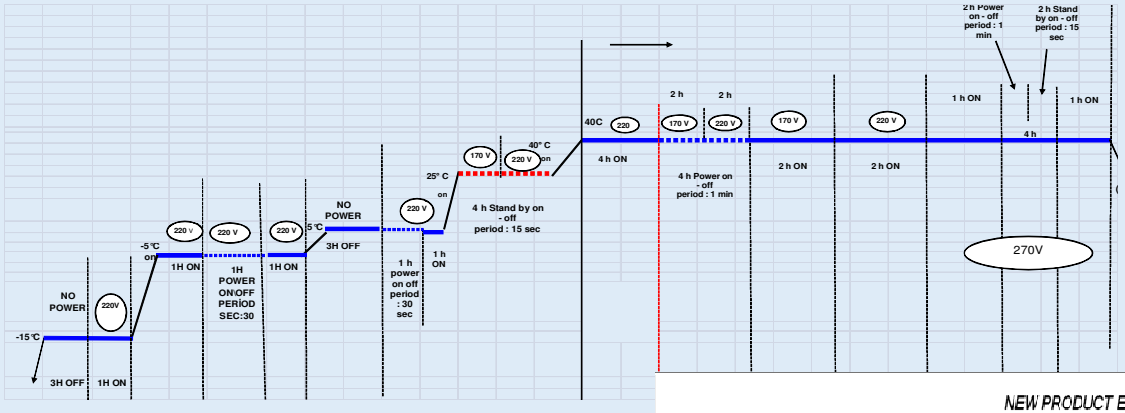
- Suitable sub system stress testing is also the cheapest / most effective method and is a MUST for complex products

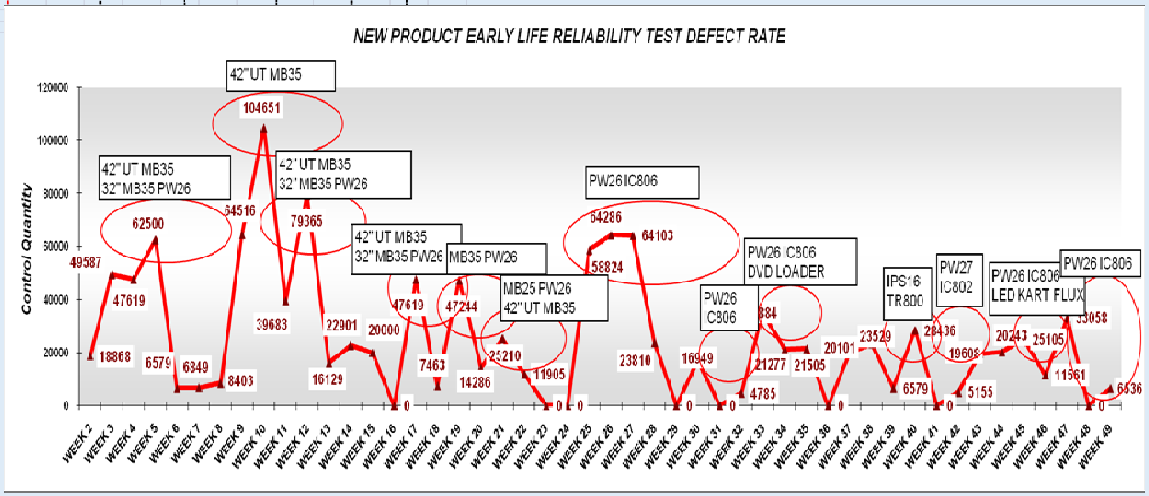


Both power board and main board				
Test No.	**Stress Test**	**Test Codition**	**Test Time**	**Test Q"ty**
1	**Thermal Shock**	From -40°C (10mins) ~ 100°C(10mins), ramp rate of 40°C--55°C/Min (Refer to IPC9701)	25hrs	30PCS
2	**Random Vibration**	10G	1hr	30PCS
3	**ICT/FT Test**	N/A	N/A	30PCS

Tailored Accelerated Life Testing

- Experimental work is a necessity to set up ‘unique’ ALT profiles for sub-systems and full products to maximise ability to precipitate latent weaknesses
- Following same old traditions DOES NOT WORK !! . A unique characterisation of product required to define best possible way of stimulating latent weaknesses





Strong DFM / DFT Assessments

- DFM / DFT is important at earliest stage of Design Cycle to prevent future process issues and inefficiencies which later lead to field failure from a non perfect process
- Organise assessment with scoring is the correct manner for benchmarking and focusing on continual improvement through improved design
- Scores then used as integral part of the overall NPI scoring model

DFM PILOT SCORING		Weight	Score	AVG	MB35	TOTAL
SOLDERABILITY	Incomplete fillets and unfilled holes	5*10	Max 10		10	
	Solder bridging (Reflow)		Max 10		5	
	Solder and Component short circuits (Selective, Wave)		Max 10		5	
	Insufficient, Poor Soldering (Reflow, Wave)		Max 10	7.83	7	39.17
	Skipping and shading during SMD soldering		Max 10		NA	
	Submarining in solder wave		Max 10		10	
	Insufficient PADs of SMD components		Max 10		10	
ASSEMBLY	Components requiring special assembly operation	3*10	Max 10		10	
	Assembly difficulties		Max 10		7	
	PCB marking (Barcode, fiducials, etc)		Max 10		8	
	Top and bottom SMD component ratio		Max 10	8.50	NA	25.50
	Insertion yields of TH components (Cycyle Time, Mach. Speed, Comp. qty, Comp. variety)		Max 10		NA	
	Insertion yields of SMD components (Cycyle Time, Mach. Speed, Comp. qty, Comp. variety)		Max 10		9	
COMPONENTS	Component body diameter	2*10	Max 10		10	
	Lead diameter		Max 10		10	
	Lead forming		Max 10		10	
	Span		Max 10	9.17	NA	18.33
	Labor incentive configuration		Max 10		10	
	Excessive vertical mountining		Max 10		10	
	Availability of component inspection		Max 10		5	
		PILOT SCORING			Max 100	83.00

The NPI Model

- All programme managers need effective methods to evaluate ‘state of product’ before launching into mass production
- Relying on personal views from engineers or managers is VERY RISKY !! ,An organised measurement approach is the answer with a scoring model to provide strength in decision making

NEW PRODUCT SCORING PRODUCT MODEL# (XXXX)				Scoring Matrix Targets
Key Measures / Review Points	Max Score	% Rating	Actual Score	
1. DFM				
EVT Score	7	60	4.2	>98%=100, 97-98%=80, 96-97%=60, 95-96%=40, <95%=0
DVT Score	8	80	6.4	>98%=100, 97-98%=80, 96-97%=60, 95-96%=40, <95%=0
Note - Scores achieved from DFM Report Score				
2. DFT (DESIGN FOR TEST)				
EVT PCBA boards	3	80	2.4	>85%=100, 80-84.9%=80, 75-79.9%=60, 70-74.9%=30, <70%=0
DVT PCBA boards	5	80	4	>95%=100, 90-94.9%=80, 85-89.9%=60, 80-84.9%=30, <80%=0
DVT Power Board Gauge R&R level (Tier 2 Supplier)	3	60	1.8	ATTRIBUTE >97%=100, 95-96.9%=80, 93-94.9%=60, 90-92.9%=40, <90%=0 , VARIABLES- <10 = 100, >10
PVT Power Board Gauge R&R level (Tier 2 Supplier)	5	80	4	ATTRIBUTE >97%=100, 95-96.9%=80, 93-94.9%=60, 90-92.9%=40, <90%=0 , VARIABLES- <10 = 100, >10
Note - Scores achieved from DFT Report Score				
3. Gross Design Maturity (DQ compliance testing / RD)				
EVT 1 score	12	80	9.6	>70%=100, 65-69.9%=80, 60-64.9%=60, 50-59.9%=30, <50%=0
EVT 2 score	10	80	8	>85%=100, 80-84.9%=80, 75-79.9%=60, 70-74.9%=30, <70%=0
DVT Score	8	60	4.8	>95%=100, 90-94.9%=80, 85-89.9%=60, 80-84.9%=30, <80%=0
Note - % Design Maturity from DQA Reporting				
4. Factory Readiness Review				
DVT Stage Compliance Score	8	80	6.4	>80%=100, 70-79.9%=80, 60-69.9%=60, 50-59.9%=30, <50%=0
PVT Stage Compliance Score	10	80	8	>90%=100, 80-89.9%=80, 75-79.9%=60, 70-74.9%=30, <70%=0
PVT First Pass Yield Full Assy	6	100	6	>95%=100, 90-94.9%=80, 85-89.9%=60, 80-84.9%=30, <80%=0
Note - Scores achieved from Supplier audit Report Score				
5. Product ELR Rel Test (Early life Reliability)				
DVT / PVT Stage	10	60	6	0 defect = 100 , 1 defect =80, 2 defect= 60 , 3 defects =40 , >3 =0
6. ALR long term reliability test (Accelerated Life Reliability)				
DVT / PVT Stage	5	100	5	PASS = 100, Failed = 0 (Any defects is Failure)
Note - Provided by Tier 1 Rel Test report				
TOTAL SCORE	100		76.6	
TARGET			85	

Working with Reliability Solutions

- Martin Shaw performs GAP analysis at new Customers wishing to run an overall Improvement Programme
  - Each of 7 Key Item areas are assessed plus additional areas he feels would feel need improvement
  - Detailed Executive Report is issued to define GAP analysis summary with list of Actions / Projects that will be required to make necessary improvements
  - Key Measurements defined that directly relate to each Project's Success level
    - Process Yields, DQA Maturity, Key Comp ppm , NPI, Field Return Rates, etc
- Project Teams are formed for each Key Improvement Project defined in GAP Analysis
  - Key individual at Client is nominated to handle Project Mgmt with Martin Shaw
- Project Schedules defined and Teams begin projects, Project Management handled by Martin Shaw and a nominated client representative for communication internally
- Outline of support required from Reliability Solutions is defined with Costs
  - Includes the on site reviews at client (recommended every 10-12 wks)