SiTime

GALAXY

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Automating Consolidated Yield Calculations at Final Test for MEMS-based Clocking Devices

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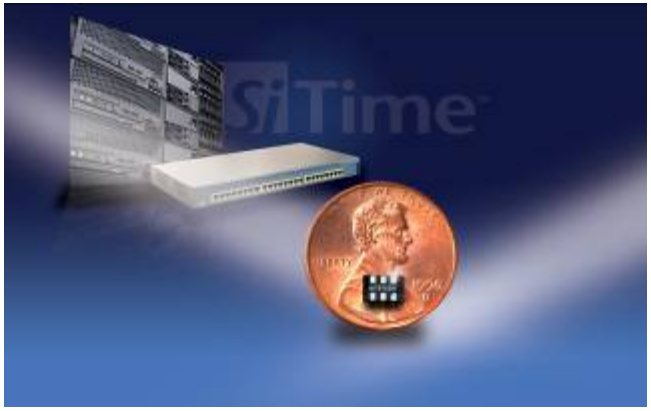
SiTime Summary

- Analog semiconductor company
- 100% silicon solutions, quartz free
- 100% pin-to-pin replacement of quartz
- MEMS & Analog IC developed & owned by SiTime
- Broadest timing product portfolio

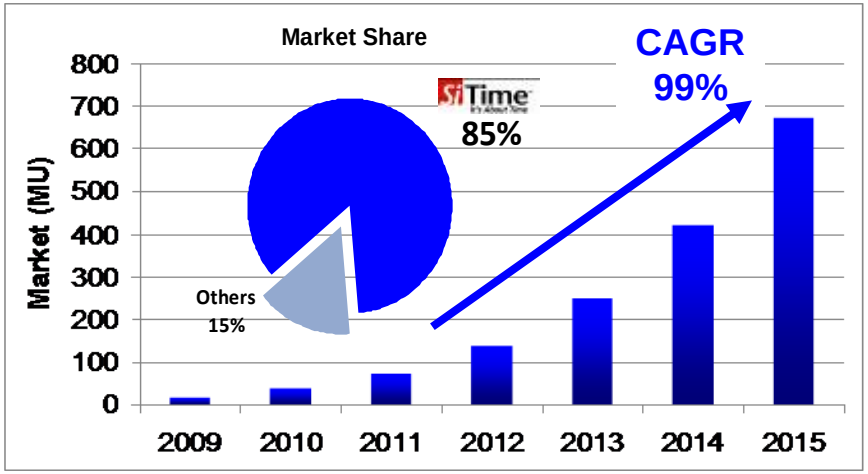


- Production shipments in the markets below
  - Computing
  - Networking
  - Storage
  - Consumer
  - Industrial, Medical, Automotive

- Benefits
  - Any frequency, accurate up to 5 decimal places
  - Best frequency stability over industrial temp. range
  - Most flexible: any combination of frequency, voltage, stability, package and more
  - Shortest lead time, 2-4 weeks
  - Smallest, thinnest
  - Most robust, reliable

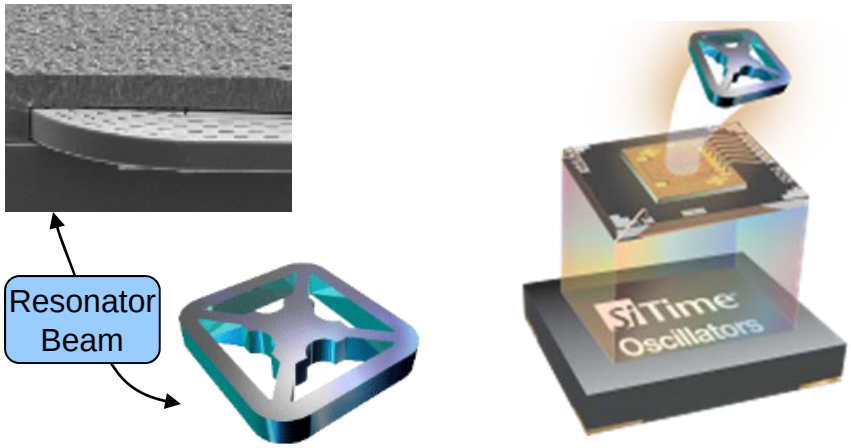
SiTime Leadership

Large, Rapidly Growing Market



Source: Yole Developpement, March 2010

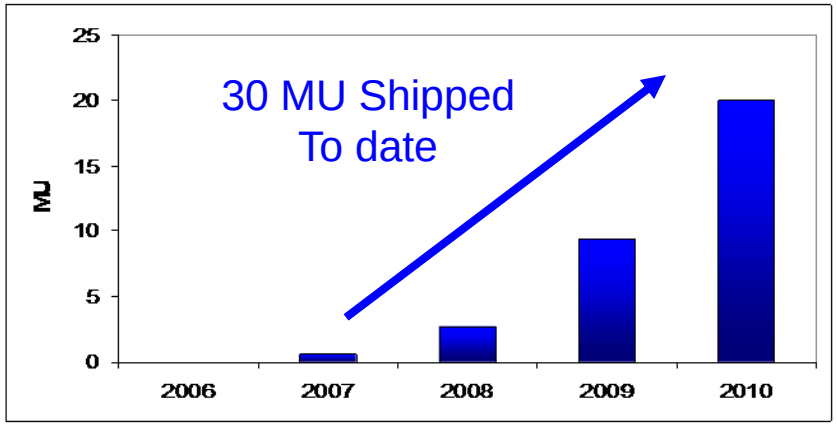
Leadership Products and Technology



Wins at Large OEMs and ODMs Worldwide

- 3 of the top 6 Computer Makers
- 2 of the top 4 Consumer Electronics companies
- 5 of the top 10 Networking makers in Asia
- 3 of the top 6 Contract Manufacturers
- 5 of the top 10 ODMs

Rapid Revenue Growth



My Role at SiTime

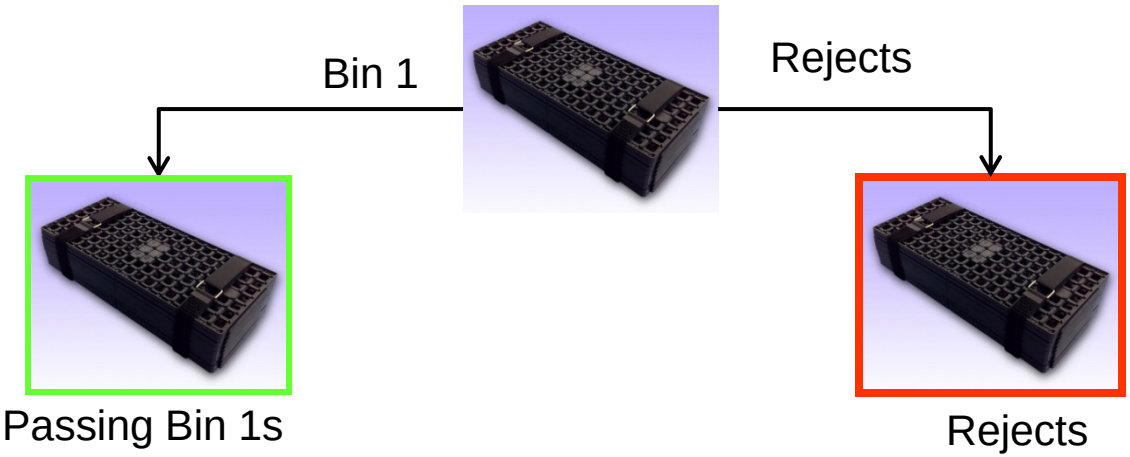
- Built the Test Engineering Team
- Created automated process flows to handle infinitely programmable devices
- Developed all automated MEMS resonator testing systems
- Lead development efforts for new technologies
- Develop new testing/programming methodologies:
  - Improve performance
  - Increase throughput
  - Reduce cost
- Oversee and maintain data flow between SiTime & subcons

How SiTime uses Galaxy Yield-Man

- Data is automatically inserted for all SiTime products:
  - Currently 14 product families, with over 25,000 programmable part numbers.
  - Data is from in-house production and from global subcons.
  - Includes Final Test, WAT, PCM, and Wafersort data
  - Currently finalizing our Galaxy Automated Yield Reports
- One major hurdle that Galaxy helped us overcome: calculation of consolidated yield data with multiple retests!

Calculating Consolidated Final Test Yields

CASE 1: Basic test flow with no retest

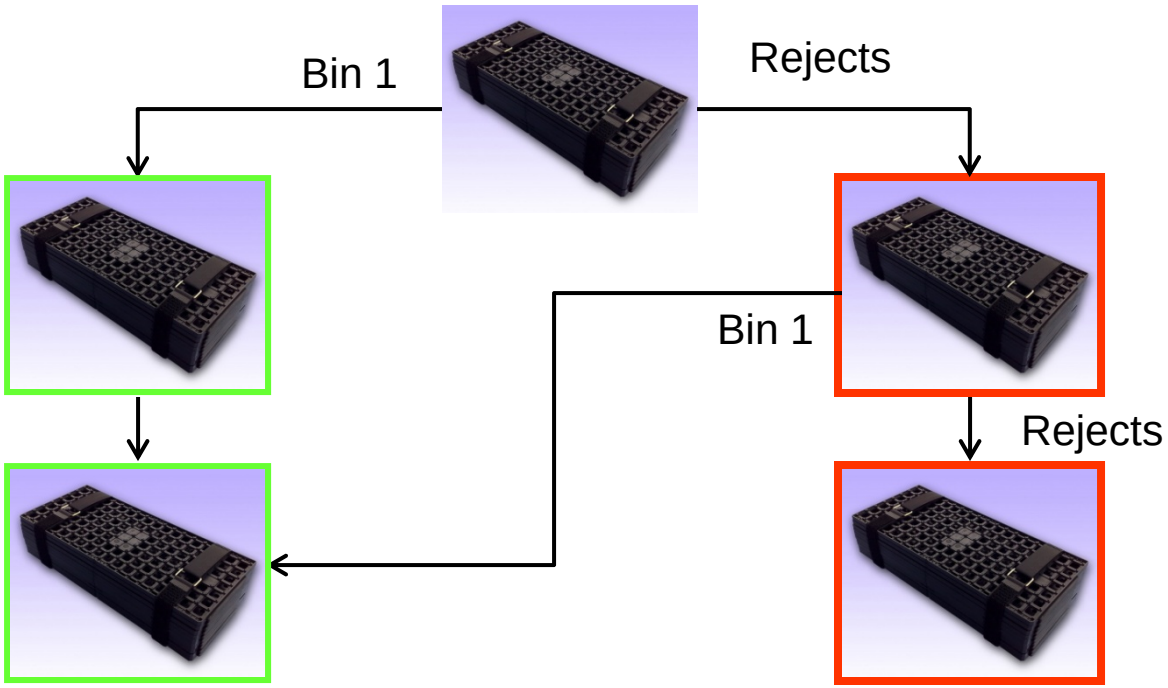


1st pass file, “P1”
(single file per test lot)

- 1 File = Easy!

Calculating Consolidated Final Test Yields

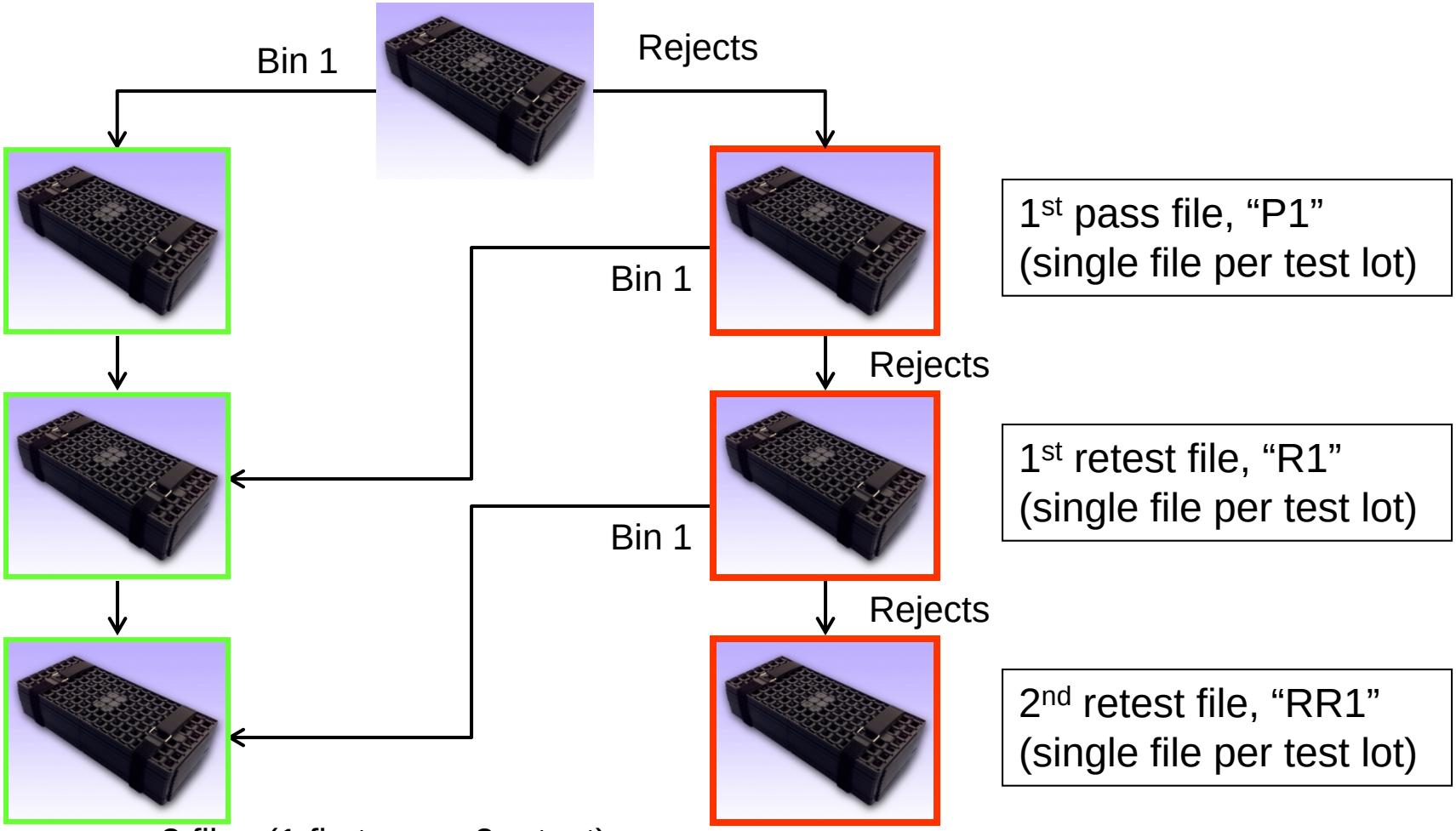
CASE 2: Add 1 retest to a basic test flow



- 2 files (1 first pass, 1 retest)
- Consolidated Yield = (P1 good + R1 good) / Total Parts

Calculating Consolidated Final Test Yields

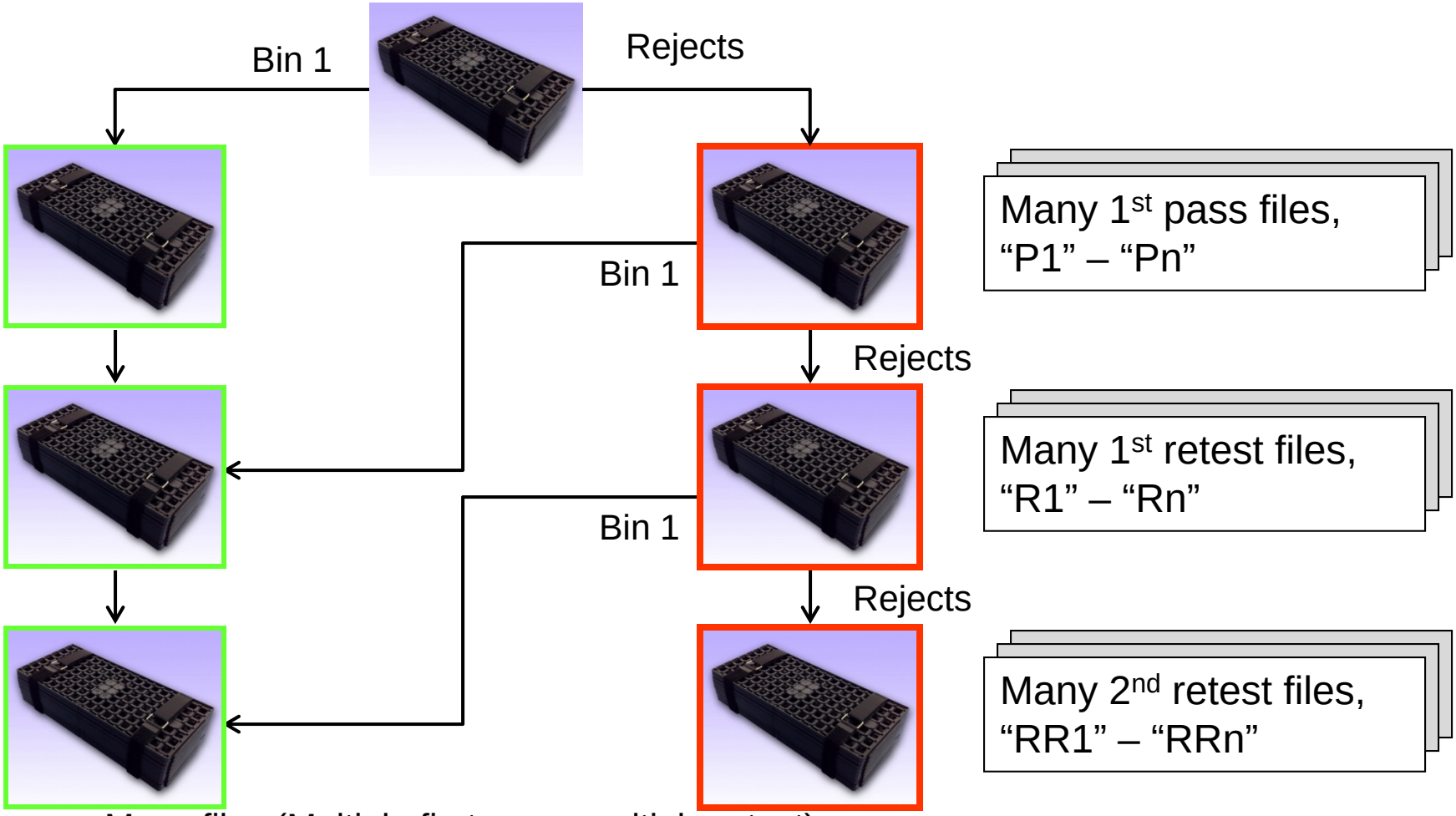
CASE 3: Add MULTIPLE retests to a basic test flow



- 3 files (1 first pass, 2 retest)
- Consolidated Yield = (P1 good + R1 good + RR1 good) / Total Parts

Calculating Consolidated Final Test Yields

CASE 3: Add MULTIPLE files & MULTIPLE retests to a basic test flow



- Many files (Multiple first pass, multiple retest)
- Consolidated Yield = (P1-Pn good + R1-Rn good + RR1-RRn good) / Total Parts

Challenges for Accurate Calculation of Consolidated Final Test Yields

- Each lot is different
  - Multiple files possible for each step (1st pass, retests)
  - Number of retests vary from lot-to-lot
- Lot quantity inconsistencies:
  - Lost parts (Less parts retested than originally failed)
  - “Created” parts (More parts retested than originally failed
- Manual calculation is possible but not efficient:
  - Many places for calculation errors
  - Templates can make it a little easier but too many variables
  - Extremely time consuming

Consolidation Calculations Automated in Yield-Man

1. Subcons already place "data type" in file name - LOTX_01_P1_21_47_39.zip:
   - P1 – Pn = 1st pass files
   - R1 – Rn = 1st retest files
   - RR1 – RRn = 2nd retest files

2. Yield-Man assigns "data type" by parsing the file name, and increments "retest_index":
   - All "P" files (1st pass) → retest_index = 0
   - Any "R" files (1st retest) → retest_index = 1
   - Any "RR" files (2nd retest) → retest_index = 2
   - Any "RRR" files (3rd retest) → retest_index = 3
   - Etc...

Example Data Types and Retest Index in the Database

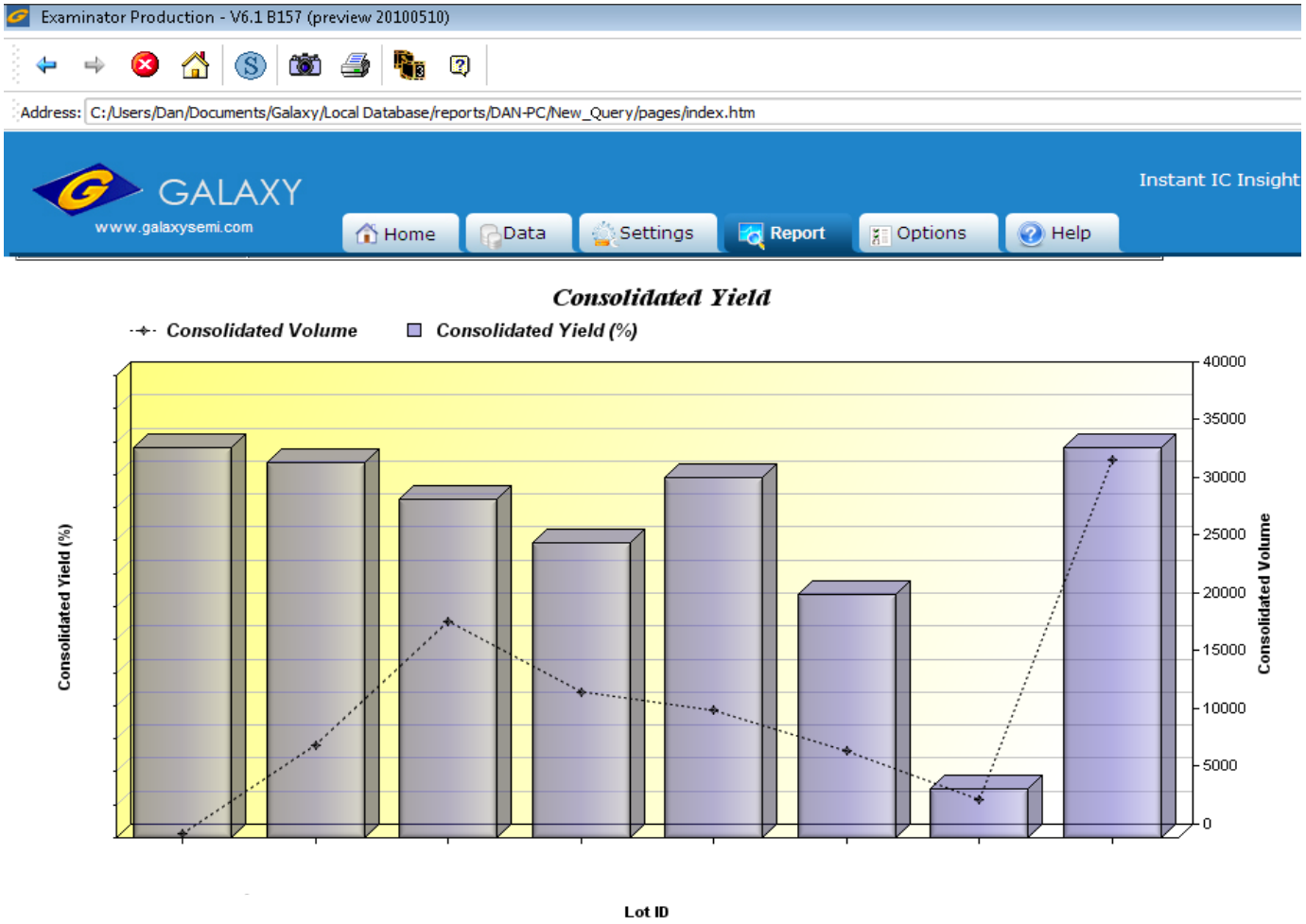
[Table] ft_splitlot @gexdb_sit (Gexdb MYSQL5.1)

File Edit View Window

Import Wizard | Export Wizard | Filter Wizard | Grid View | Form View | Memo | Hex | Image

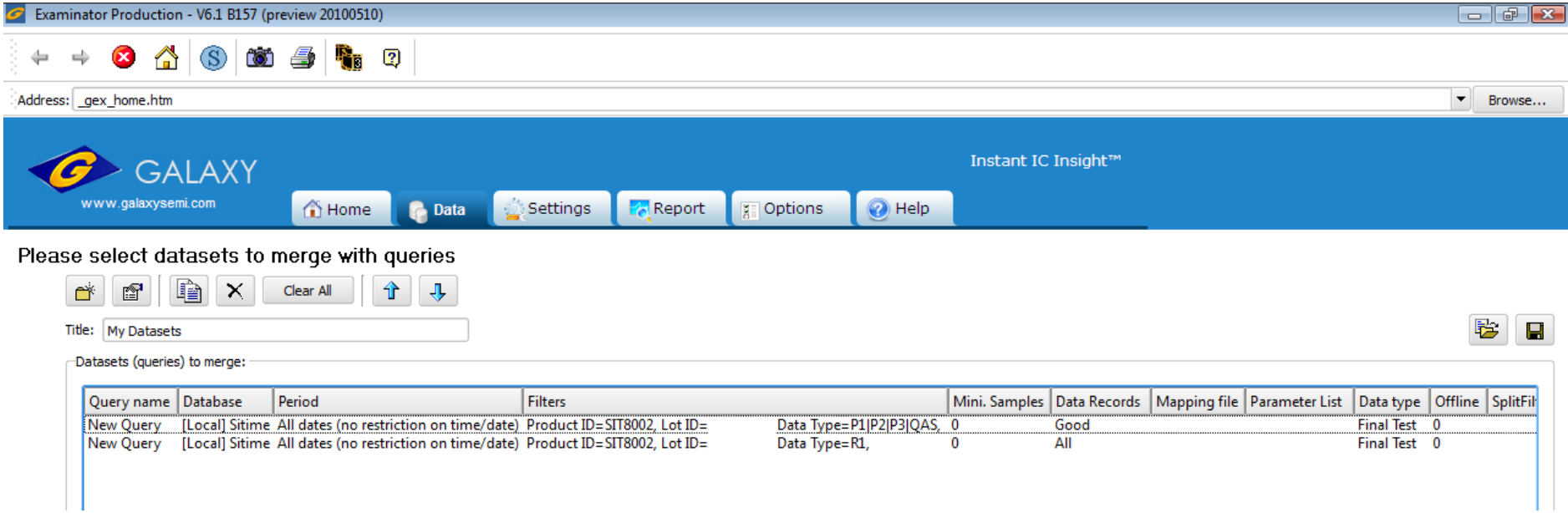
data_type	prod_data	retest_index	retest_hbins
QA2	N	0	(Null)
QA3	N	0	(Null)
QAS	Y	0	(Null)
QAS	Y	0	(Null)
QAS	Y	0	(Null)
R1	Y	1	all_fail
CR_QAS	N	0	(Null)
CR_R1	N	1	all_fail
QA12	N	0	(Null)
P2	Y	0	(Null)
P1	Y	0	(Null)
P1	Y	0	(Null)
QAS	Y	0	(Null)
R1	Y	1	all_fail
RR1	Y	2	all_fail
P1	Y	0	(Null)
P1	Y	0	(Null)
P1	Y	0	(Null)
P2	Y	0	(Null)
P2	Y	0	(Null)
P2	Y	0	(Null)
P3	Y	0	(Null)
R1	Y	1	all_fail
P1	Y	0	(Null)
P1	Y	0	(Null)
P1	Y	0	(Null)
P2	Y	0	(Null)

Example Consolidated Yield Graph – Weekly report



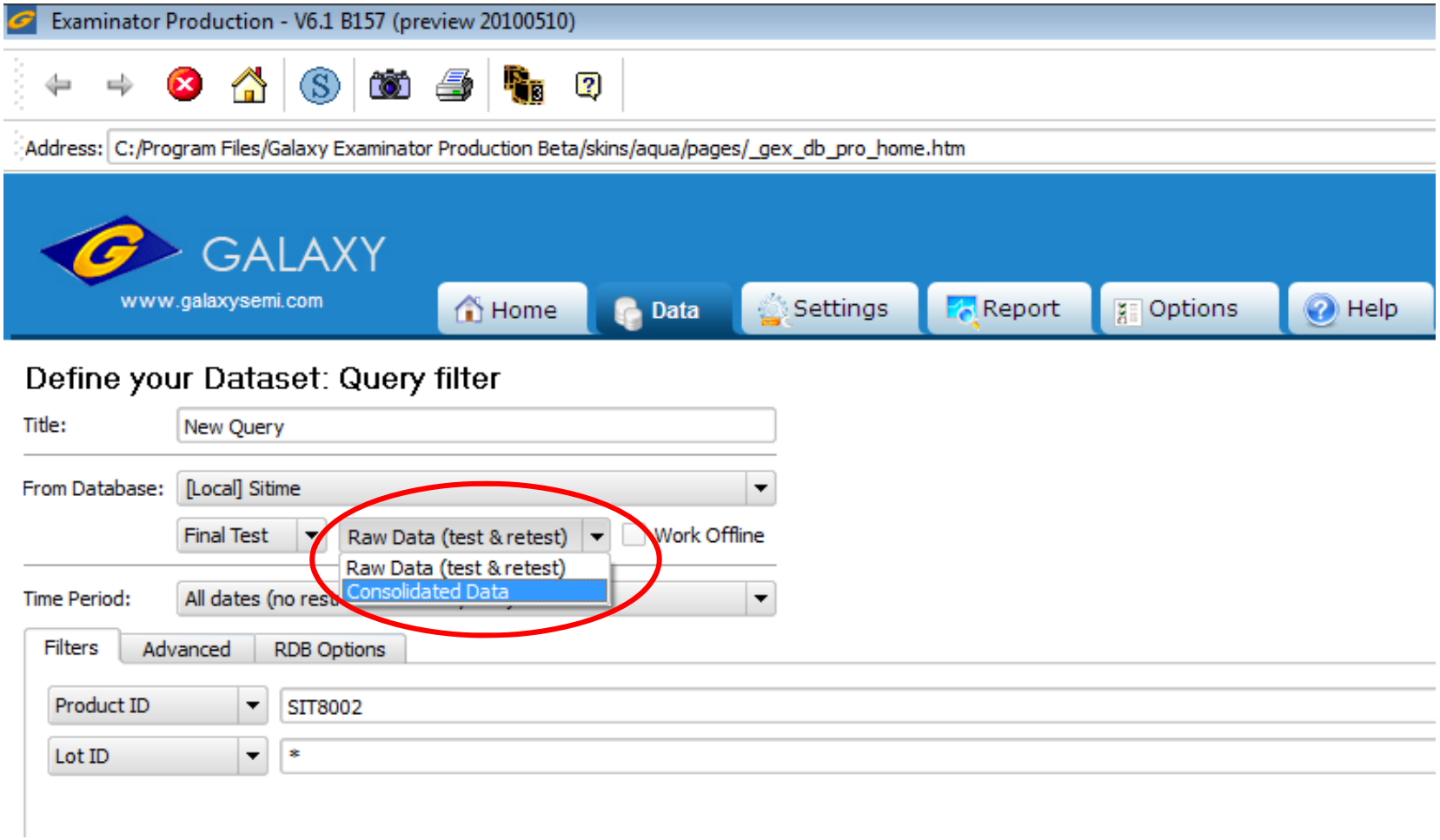
Consolidated Paretos, Histograms, Stats pre-Yield-Man

- Lots can have 0, 1, 2, 3 retests
- For each lot, user intervention was required:
  - Count the number of retests
  - Include “Bin 1” only from all files except the last retest
  - Include all parts from the last retest files

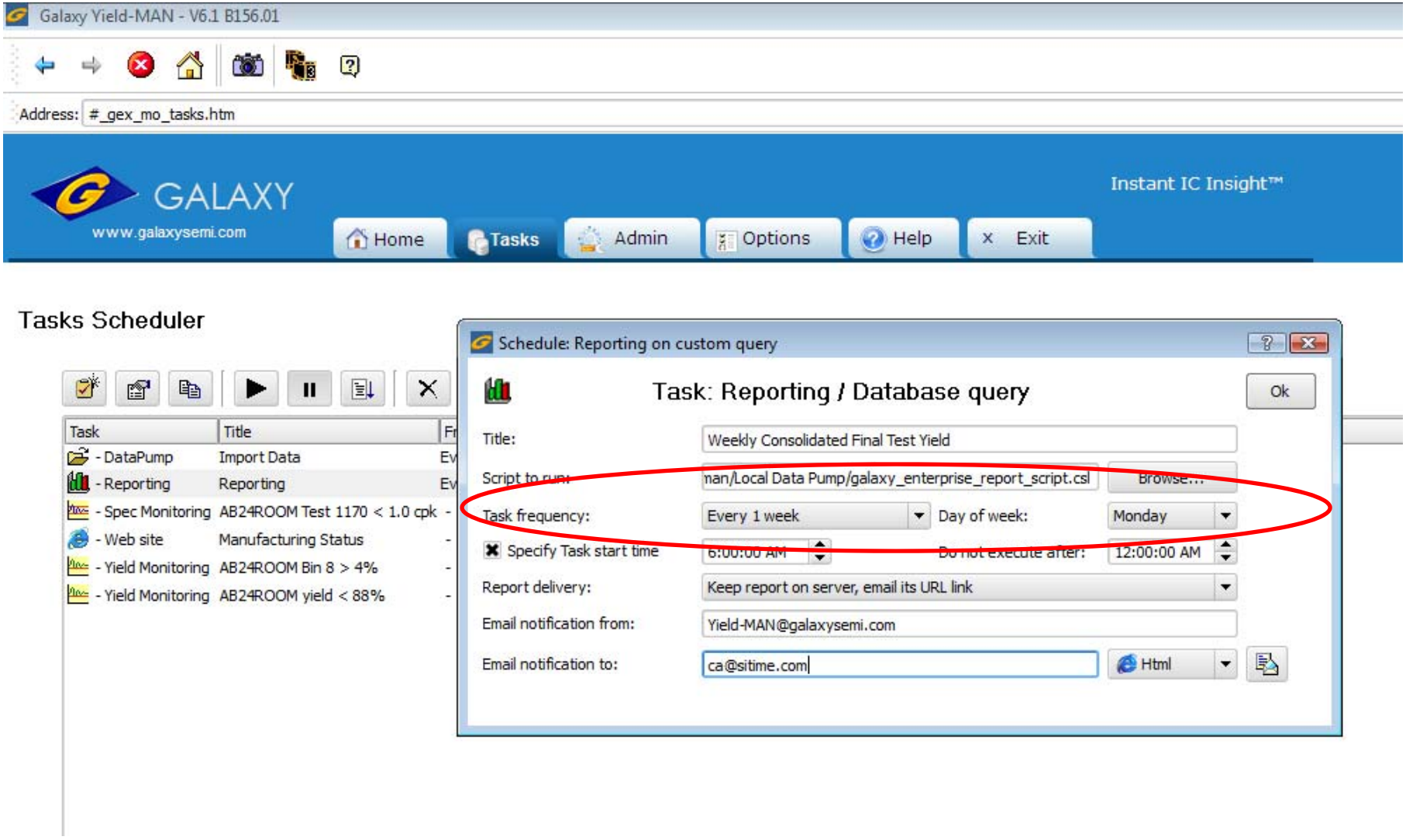


Automating Consolidated Data with Yield-Man

- Now this is done with <u>one click</u>

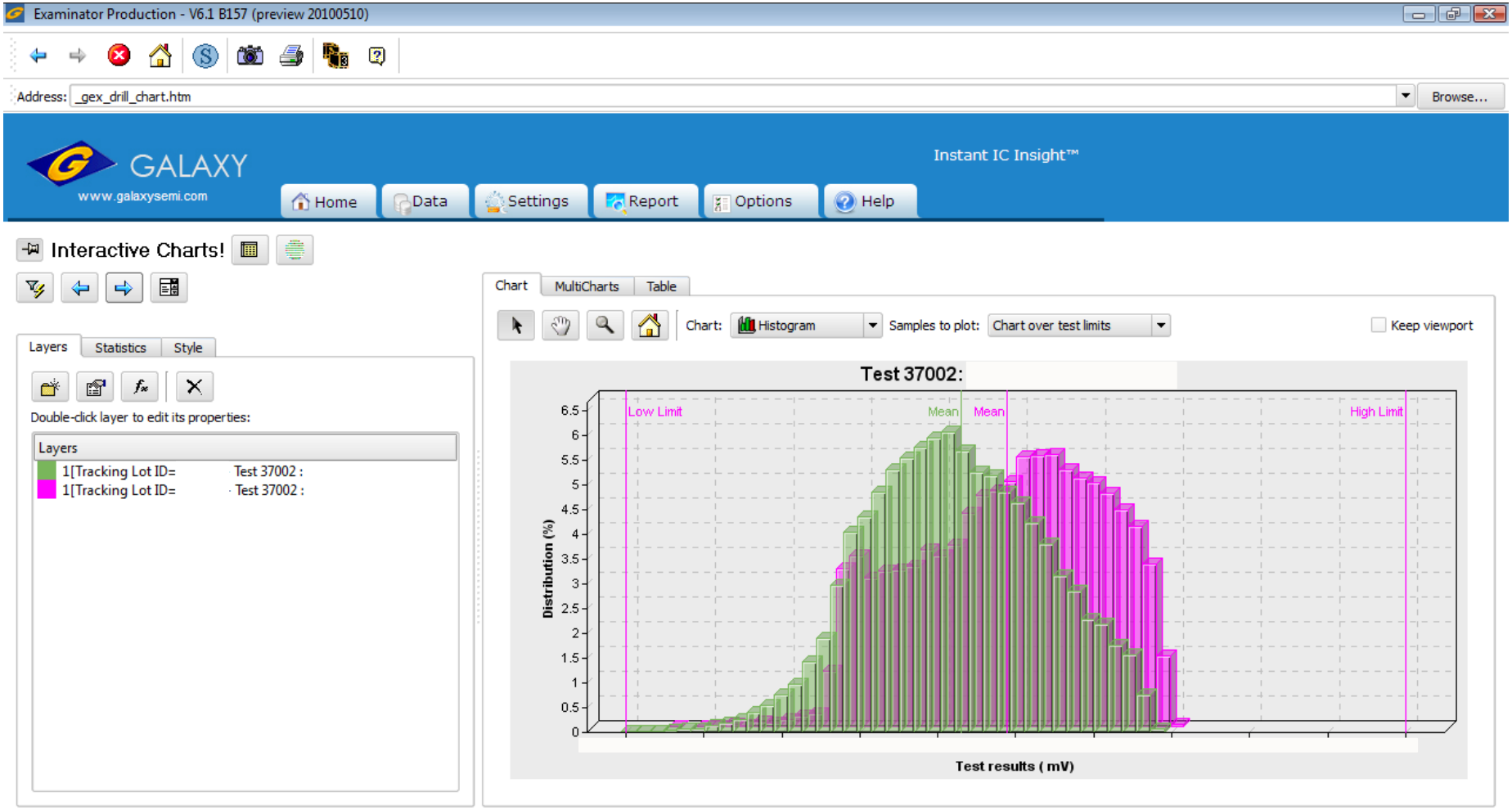


Automating the Consolidated Yield Graph – Weekly report



Automating Parametric Graphs & Statistics with Yield-Man

- We now easily analyze the correct consolidated data



Yield-Man Has Saved us Time & Money

- Allows our engineers to spend time solving problems instead of…
  - Manually collecting and storing data
  - Filling out spreadsheets for yield graphs
  - Manually creating consolidated reports for each lot
  - Manually importing and filtering files for consolidated stats, histos, and paretos
- Accurate data analysis capabilities has been key to
  - Improving process & throughput
  - Reducing our production costs!