



Bird[®]

What will you get from this class?



Class description

*The **7037 0.5% Pulse Power Sensor** emerged from Bird's advances in calorimetry. Learn about key features such as multi-level-pulsing and time domain analysis, which are crucial for the latest semiconductor processing recipes. Enhancements versus the industry-standard 4027 Series Sensors will also be explored.*

Application Overview

Who are the customers?

What are user's pain points?

Product Overview

Competition

Key Questions to Ask

Sales Tools



Background:

- Consistency is a critical element of semiconductor manufacturing
- Better process repeatability allows recipes to be finetuned to improve performance and reduce yield loss
- RF power measurement at various points in the feedline provides insight to process performance.



Post-Matching Network Measurement:

- Enhanced visibility of chamber performance
 - Delivered RF power into chamber
 - Chamber impedance changes
 - Micro-arcing detection



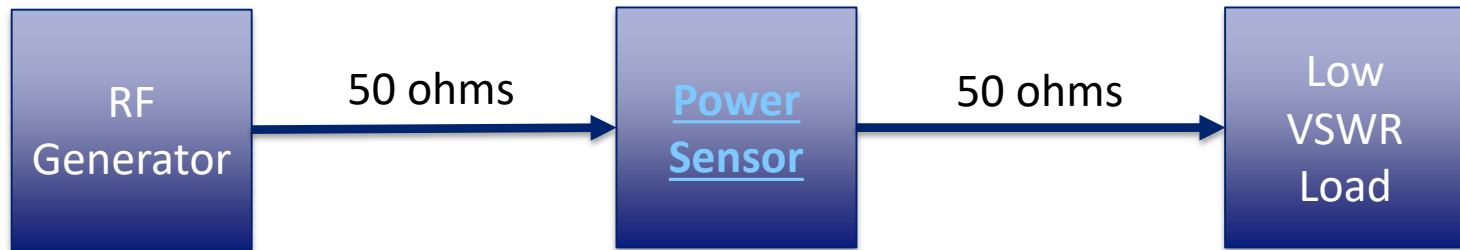
Pre-Matching Network RF Measurement:

- Monitors generator performance
 - Setpoint accuracy
 - Amplitude drifts
 - Pulse shape consistency
- Detects matching network performance issues



Generator Characterization

- Generator consistency is crucial for semiconductor manufacturing
 - Predictable results
 - Tool-to-tool consistency
- Conducted off-line with RF energy being dissipated in a low VSWR load
- Line loss can also be characterized by including the RF delivery path
- Historically focused on Continuous Wave (CW) Generators with 1% measurement accuracy



Application Overview

CW Generator Characterization

- Critical parameters:
 - Setpoint accuracy
 - Setpoint repeatability
 - Linearity over power range
 - Stability over time



Application Overview

Bird 402x Series CW Power Sensor:

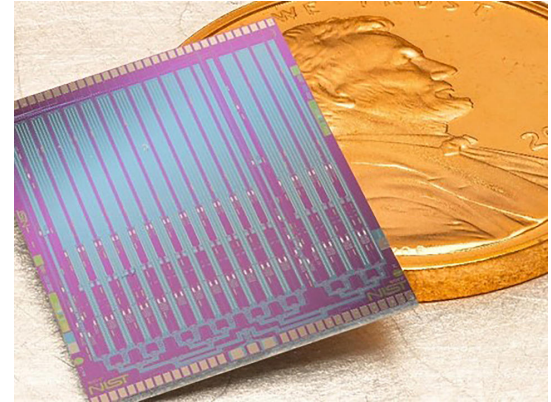
	4021 thru 4025	4027A	4027F	4028
Frequency Range*	0.1 – 3000MHz	.25 – 170MHz	1.8 – 63MHz (with filtering)	.25 – 25MHz
Power Range*	Up to 10kW	Up to 10kW	Up to 10kW	Up to 50kW
Accuracy	3%	1% at cal frequency and power level	1% at cal frequency and power level	2% at cal frequency and power level

* Frequency and power ranges are model dependent



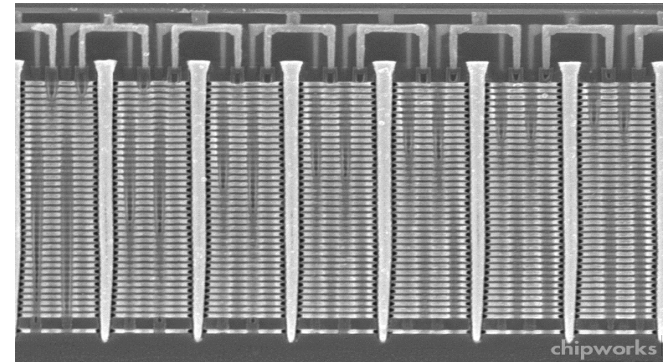
Latest Requirements: Pulsing RF Generators

- The trend in semiconductors continues to be smaller geometries, better yields and reduced processing times
 - Controlling plasma is pivotal
 - Pulsing RF power allows:
 - Improved selectivity
 - Higher etch rates
 - Better uniformity
 - Reduced structural damage



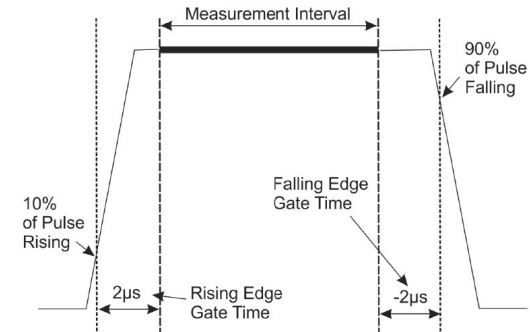
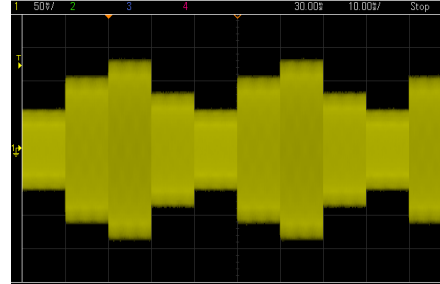
Latest Requirements: Higher Accuracy RF Generators

- The trend in semiconductors continues to be smaller geometries, better yields and reduced processing times
 - RF power accuracy to 0.5% is also pivotal
 - Higher accuracy provides:
 - Consistent plasma energy
 - Uniform ion density
 - Predictable etch rate
 - Overall process repeatability



Pulse Generator Characterization

- Critical parameters:
 - Setpoint accuracy
 - Setpoint repeatability
 - Linearity over power range
 - Stability over time
- Pulse level accuracy
 - Single level (On- Off)
 - Multi-level
- Pulse shape accuracy
 - Rise / fall time
 - Rep rate
 - Duty cycle



Who are the customers?



OEMs

Semiconductor tool OEMs who are developing new processes and test-sets

- Applied Materials
- LAM Research
- Tokyo Electron

Generator OEMs

- AE
- MKS
- Kyosan
- Daihen

Fab and foundries

Manufacturing sites that utilize RF power

- Intel
- Samsung
- Micron
- TI
- GlobalFoundries



Who are the customers?

Persona #1: Development / Metrology Engineer

Objective: Qualifying generators for use

Primary Focus: Ensuring delivered RF power meets process requirements

Workflow Task:

- Measure RF output at regular intervals
- Capture and record data of Critical-To-Quality parameters



What are the user's pain points?

Persona #1: Development / Metrology Engineer

Pain points:

- Separate setups needed to measure different parameters
- Multiple test points results in a lengthy calibration process

7027 and 7037 Sensor Benefits:

- In addition to providing calibrated measurements, the included VPM3 software allows the user to analyze pulses in the Time Domain
- Standard Commands for Programmable Instrumentation (SCPI) programming allows process automation



Bird Pulse Power Sensor Value Proposition

For semiconductor engineers who require the highest accuracy in their pulsed RF power sources, we provide a precision power sensor that details the key characteristics of the pulses being generated.

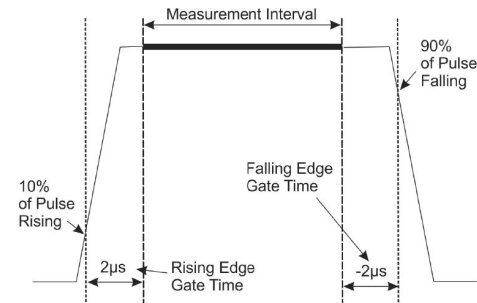
Unlike our competitor's solutions, the 7027 and 7037-Series Power Sensor provides a cost-effective measurement device that is calibrated using Bird's advanced calorimetry to provide up to 0.5% accurate readings of gate-settable intervals within a multilevel pulse.



7027 and 7037 Sensor Overview



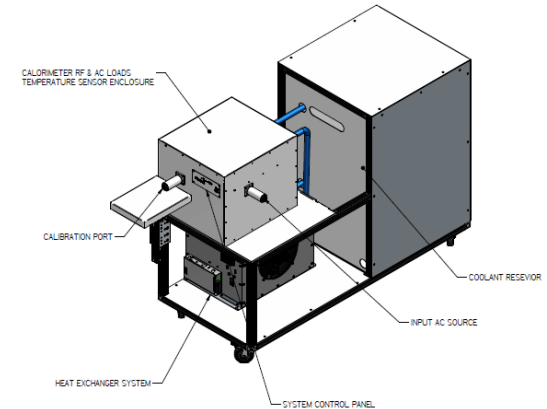
- High accuracy
 - 1% and 0.5% accuracy of pulse power
 - Accuracy holds over dynamic range
- Frequencies
 - Available in the most common semiconductor frequencies including 13.56 MHz and 400 kHz.
 - Additional frequencies will be made available as required by our customers
- Pulse measurements
 - Measures power between settable gates
 - More than one set of gates can be used to measure power simultaneously
 - True Average Power Mode still available



7027 and 7037 Sensor Overview



- Calibration
 - Calibration traceable to NIST
 - No field calibration required
 - 6-month recommended calibration interval
- Enhanced accuracy
 - The 7037 0.5% Sensor utilizes the latest advances in Bird calorimetry
 - Integration of low-frequency reference standard and source
 - Automation to allow computer controlled management of the process
 - Improvements in response time, stability and repeatability result in tighter tolerances in power measurement



7027 and 7037 Sensor Overview



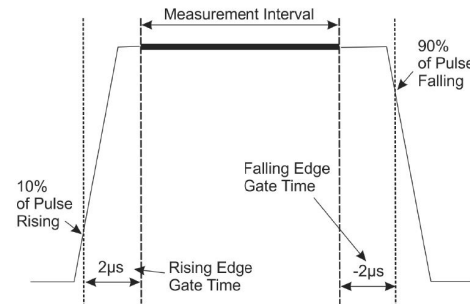
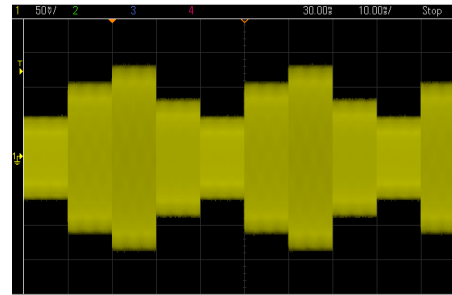
- Higher power versions
 - We have already scaled up the design with the 7029 Series using a significantly larger line section.
 - Average power levels up to 25 kW
 - Peak power levels up to 50 kW
- Options
 - Includes the VPM3 Software
 - Programmable using SCPI command set
 - Many different RF connector options available
- Many development partners for custom versions
 - Generator manufacturers
 - Tool manufacturers
 - Chip manufacturers



7027 and 7037 Sensor Overview

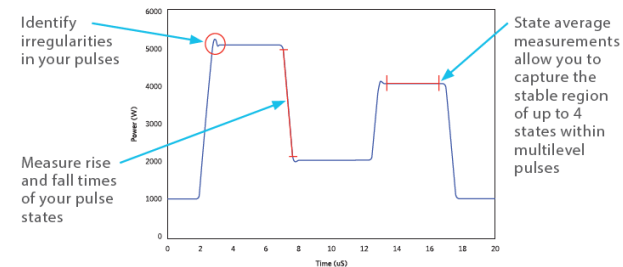


- Multi-level Pulsing
 - Up to 4 sets of gates
 - Start and stop time from a sync signal
 - Provides flexibility for the user to define each measurement interval
- Time Domain Analysis
 - Provides a view of the pulse shape
 - Allows marker setups to quantify any areas of interest
- 70x7 improvements versus the 402x Series
 - Direct sampling for pulse measurements
 - Improved linearity over the power range
 - This benefits both pulse and CW readings



ANALYZE COMPLEX RF PULSE WAVEFORMS

Utilize up to four sets of gates to analyze complex pulses



7027 Sensor Overview

Bird 7027 Series Pulse Power Sensor (1% accuracy):

Model	Freq Range	Power Range	Pulse Rep Rate
7027-1-524001-xyyy	0.4MHz /- 10%	25W to 25kW	10Hz to 11.25kHz
7027-1-544601-xyyy	2MHz +/- 10%	10W to 5kW	10Hz to 50kHz
7027-1-594301-xyyy	13.56MHz +/- 5%	10W to 10kW	100Hz to 100kHz
7027-1-604801-xyyy	27.12MHz +/- 5%	10W to 3kW	100Hz to 100kHz
7027-1-615501-xyyy	40.68MHz +/- 5%	75W to 7.5kW	100Hz to 100kHz
7027-1-624901-xyyy	60MHz +/- 5%	30W to 6kW	100Hz to 100kHz



7037 Sensor Overview



Bird 7037 Series Pulse Power Sensor (0.5% accuracy):



Model	Freq Range	Power Range	Pulse Rep Rate
7037-1-524001-xyyy	0.4MHz $\pm$ 10%	25W to 25kW	10Hz to 11.25kHz
7037-1-595701-xyyy	13.56MHz $\pm$ 5%	100W to 10kW	100Hz to 100kHz
7037-1-625801-xyyy	60MHz $\pm$ 5%	60W to 6kW	100Hz to 100kHz

Additional models are planned

What makes the 7037 Pulse Sensor unique?

- Ease of use
 - Multiple connector configurations
 - USB or Ethernet communication (with bridge module)
 - Customizable with an interlock bracket
- 0.5% accuracy for RF Power
 - Backed by Bird's proven calorimetry
- Accurate measurement across the dynamic range
 - Calibration is specified across the sensor's power range
- Advanced software tools included with the VPM3
 - Forward and reflected power
 - VSWR and return loss
 - Pulse rep rate, duty cycle, rise/fall times



1. How are you currently measuring generator performance?
2. How are a generator's Critical to Quality performance parameters identified?
3. What data is being analyzed to root-cause yield loss?
4. How is equipment drift detected?
5. What is it about your system that you like and don't like?
6. How confident are you in the results?
7. What are the frequencies and power levels in your application?





Prospecting Toolkit

- Datasheet
- Webinar
- Maximizer contacts

Points of Differentiation

- Questions to Ask
- Competitive Selling Guide



First Customer Meeting

- Product PowerPoint Slides
- Leave-behinds:
 - Datasheet
 - App Notes

Second Customer Meeting

- Product Demonstration or Webex