American Standard Circuits

Sunstone Circuits

COLLABORATE TO WIN

Manufacturing PCBs in the USA since 1972

West Chicago, IL

Mulino, OR

American Standard Circuits
Sunstone Circuits

LEADERSHIP TEAM

Anaya Vardya
President & CEO

Doug Palladino
VP Finance

David Lackey
VP Business Development

Bob Duke
President Global Sourcing Division

Matt Stevenson
General Manager

Mohammad Khan
Director of Operations

Lance Riley
Director of Strategic Programs

John Johnson
Director of Quality

American Standard Circuits
Sunstone Circuits

CORE COMPETENCE

- Managing a Diverse Product Mix
- Complimentary Design Software
- QuickTurn Prototype -Turn Key Assembly
- Online Quoting & Ordering
- Supply Chain Management
- Thermal Management Expertise
- Flex & Rigid-Flex Solutions
- High Frequency/Speed Solutions
- Advanced RF & Microwave Solutions
- Global Solutions

American Standard Circuits
Sunstone Circuits

ASC - West Chicago

Dedicated Customer Service

- Quote thru Delivery
- "Our Experts are Your Experts"

Internal R & D Group

- Customized Solutions & Consulting for a variety of technologies

Supply Chain Solutions-Stocking Programs

- Finished Goods
- Specialty Laminates

Free DFM

- ASC DFM Report

Seamless Manufacturing Model

- Rapid Prototype-Assembly TurnKey with single purchase order
- Prototype/Low Volume Production to Mid/High Volume
- Low-Cost Manufacturing Alliances

American Standard Circuits
Sunstone Circuits

Sunstone - Oregon

Online Account

- Save & View Quotes
- Re-Order Existing Parts
- View & Print Invoices

PCB Design Software

- PCB123® CAD Tool
- Schematics & Layouts
- Dynamic PCB Cost as you design

DFM & Stencils

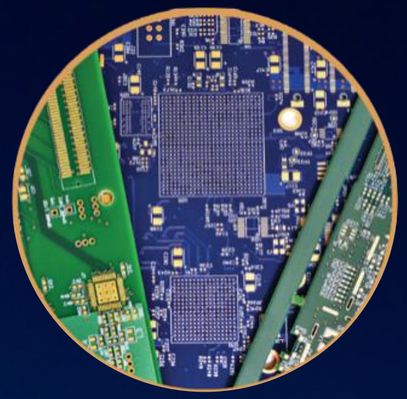
- See DFM Report
- Laser-cut Stencils

Partner for Rapid Assembly Services

- Assembly turnarounds within 24/48 hrs
- Options for kitted or turnkey solutions
- Rapid Prototype - Assembly TurnKey with single purchase order

American Standard Circuits
Sunstone Circuits

PRODUCT CAPABILITIES



Digital PCB

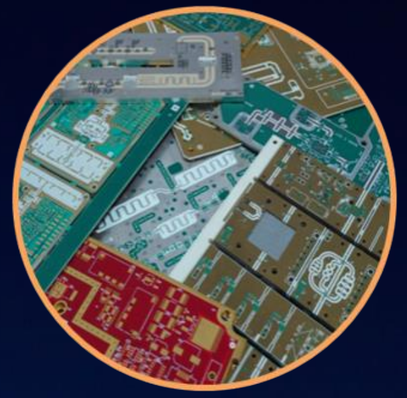
- 34 Layers
- HDI Via Structures
- Ultra HDI

Flex

- 10 Layers
- HDI Via Structures
- Ultra HDI

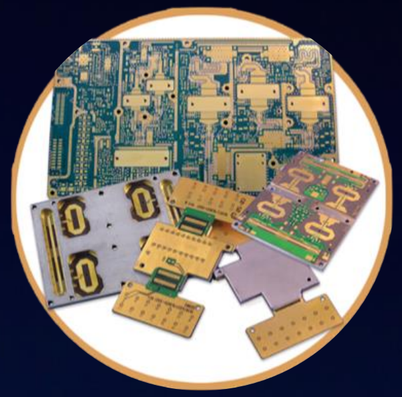
Rigid-Flex

- 28 Layers
- HDI Via Structures
- Ultra HDI
- 28" Long
- Book Binder



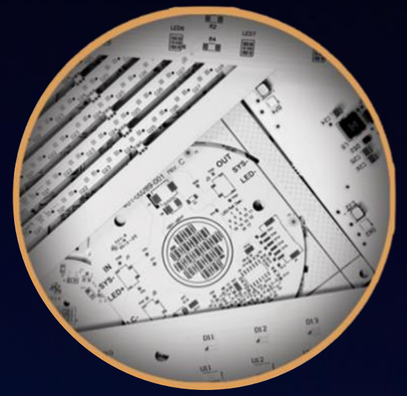
RF/Microwave Hybrid

- HDI Via Structures
- Ultra HDI
- Cavity Structures



RF Metal Backed

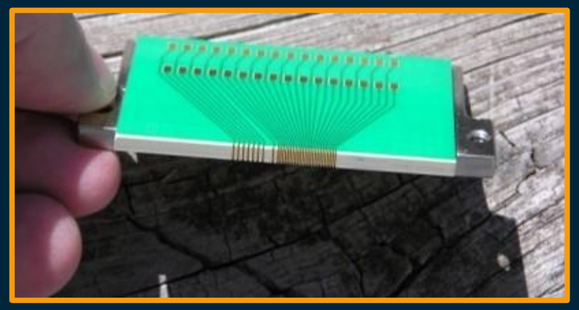
- Pre-Bond
- Post-Bond
- In-House Machining/ Plating

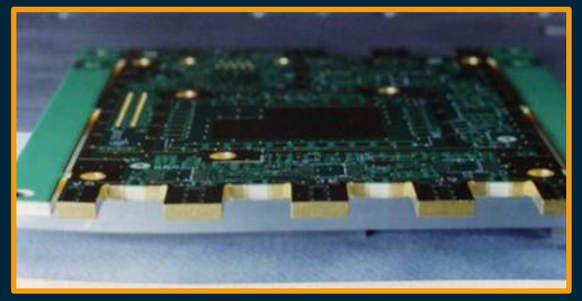


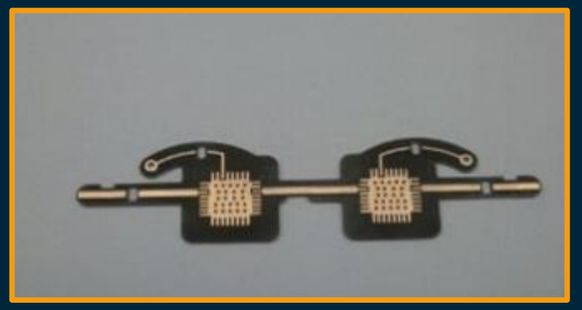
IMPCB

- Single Sided
- Multi-Layer Construction
- Metal Core
  -Copper
  - Aluminum

American Standard Circuits
Sunstone Circuits







ENABLING TECHNOLOGIES

- HDI
- Via Fill (Non-Conductive & Conductive)
- Edge Plating & Castellation
- Embedded Coins
- Control Depth Milling
- Laser Routing
- Selective Surface Finishes
- Back-Drilling
- Positive Etch-back
- Hybrid Teflon Multilayers
- Heat Sink / Metal Core Boards
- Cavity Constructions
- Selective Copper Electroplating
- Buried Resistors / Capacitors
- Heavy Copper (Up to 8 oz.)
- Fusion Bonding

American Standard Circuits
Sunstone Circuits

ADVANCED MATERIALS

OVER 1 MILLION $ SPECIALTY MATERIALS IN STOCK

Flex Materials
Cyanate Ester &
Polyimide
LCP

All Rogers, Duroid &
Arlon RF Microwave
Materials

- (3000 / 4000 / 5000 /
  6000 series materials)

AGC Taconic
Microwave Materials

- High Speed Digital
  Materials

Isola Microwave
Materials

- I-Speed / I-Tera / Astra
  / Tachyon

AGC Neltec Materials

- Microwave / High Speed
  Digital Materials

Panasonic Materials

- Megtron 4, 6 & 7

Pb Free Compatible
FR-4 / CTI 600

Aismalibar / Bergquist
(TClad) / Laird / Totking /
Ventec and Other LED
Materials

American Standard Circuits
Sunstone Circuits

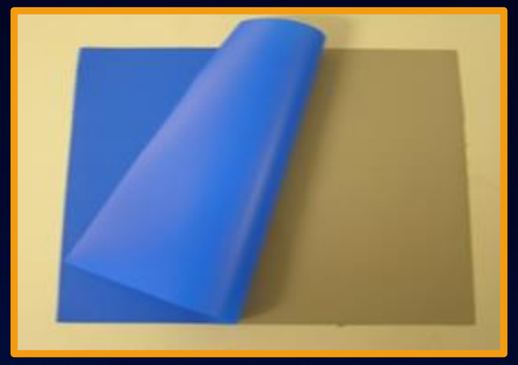
SURFACE FINISH OPTIONS

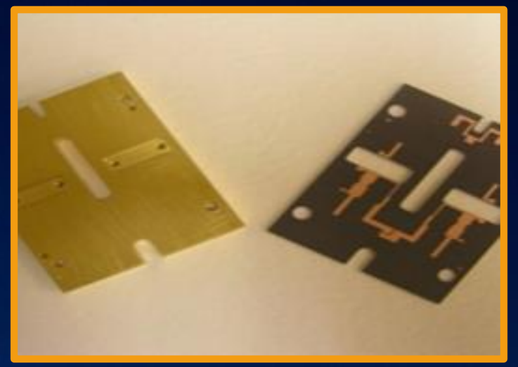
- Electroless Nickel Immersion Gold (ENIG)
- Immersion Silver
- Electrolytic Hard/Soft Gold
- Organic Surface Preservative (OSP)
- Lead Free Hot Air Level (LFHASL)
- Hot Air Solder Level (HASL)
- Plated Tin-Lead & Hot Oil Reflow
- Immersion Tin
- ENEPIG
- EPIG

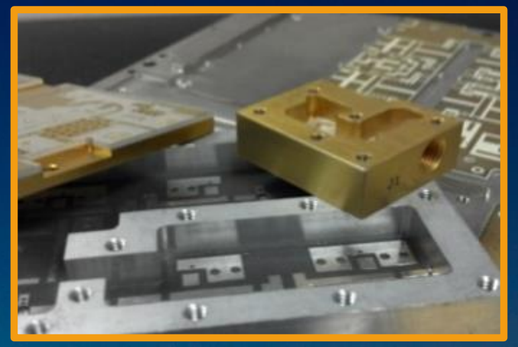
American Standard Circuits
Sunstone Circuits

METAL BACKED RF PCBS

Comprehensive Thermal Management







Offering

- Three Patents
- Custom Thermal Materials

Pre-Bonded

- ROGERS & TACONIC laminates include Aluminum, Copper and Brass

Post Bonding

- Aluminum, Copper, Brass and other metals including coin attach
- Manufacture PCB, Fixtures, Metal Carriers in house
- In house plating of heatsinks/carriers per customer specification
- Au, Ag, Sn/Pb, Ni, Alodine and Clear Chromate (RoHs)

PCBs Bonded Using

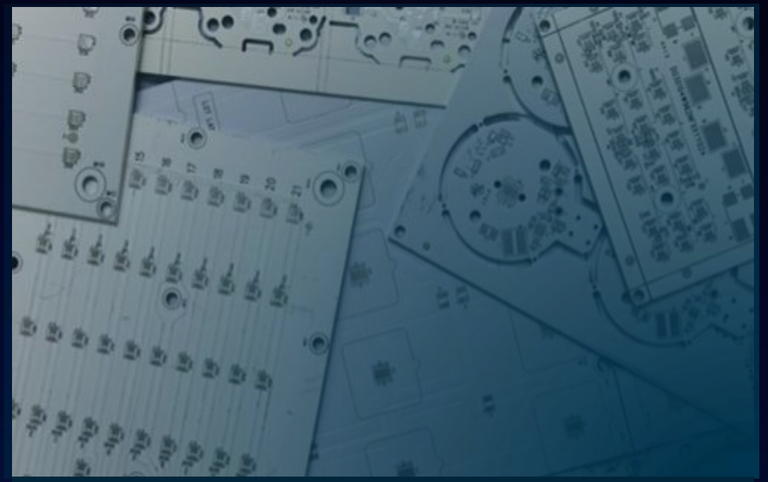
- Electrically Elastomer & Epoxy
- Lead Free Sweat Solder

American Standard Circuits
Sunstone Circuits

INSULATED METAL BOARDS (IMPCB)

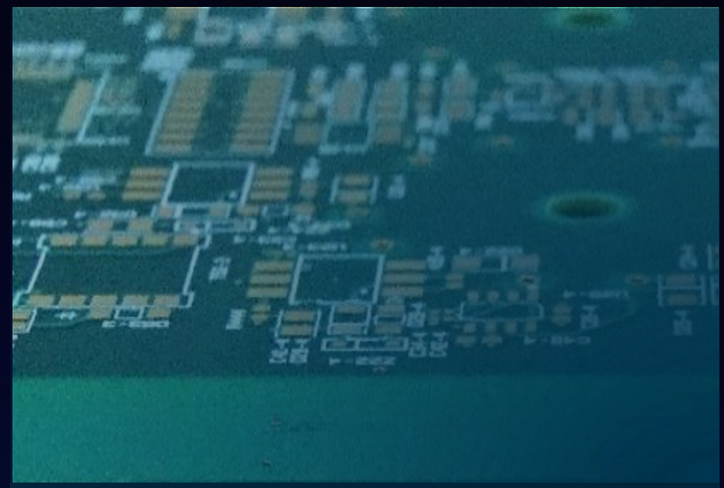
Product Portfolio

- Single Sided IMPCB
- Double Sided/Multi-layer IMPCB
- Metal Core Boards
  -*(Aluminum and Copper in-house Milling)*



Metal

- Aluminum 6061 or 5052
- Copper C110



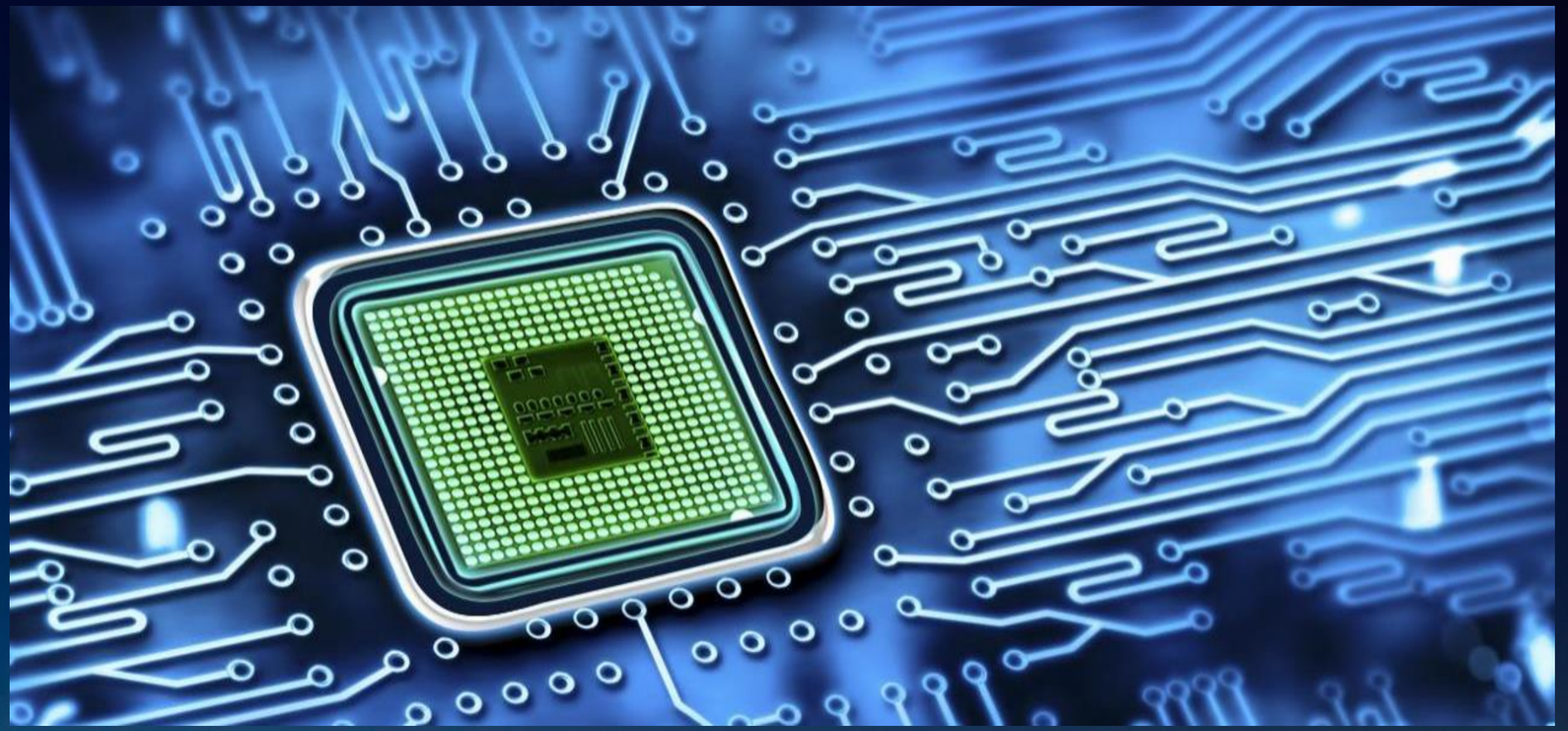
Extensive UL Portfolio

- Aismalibar
- T-Clad (Bergquist)
- Boyu
- Totking
- Ventec

American Standard Circuits
Sunstone Circuits

ULTRA HIGH-DENSITY INTERCONNECTS

Mils to Microns

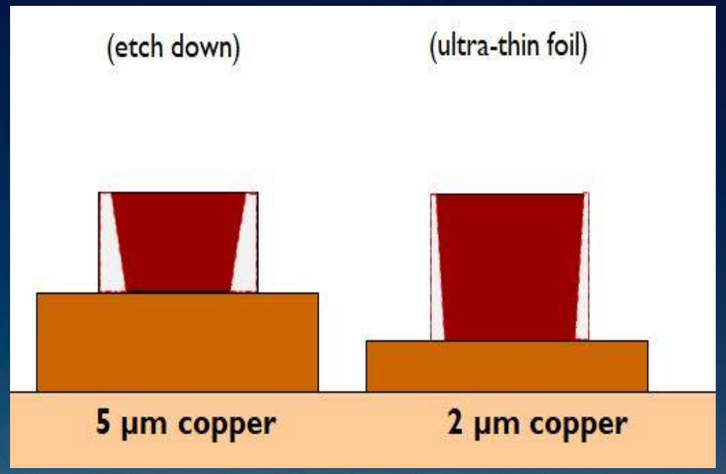


American Standard Circuits
Sunstone Circuits

UHDI Methods

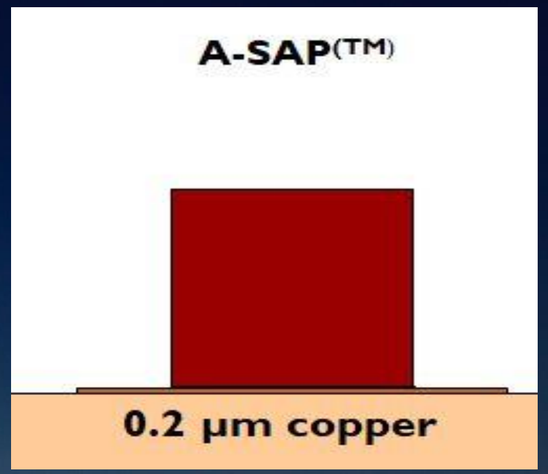
Ultra Thin Foils

- Starting with thin/ultrathin foils or foil thickness reduction
- Limits around 25 um
- Relatively straight sidewalls with some etch of sidewall



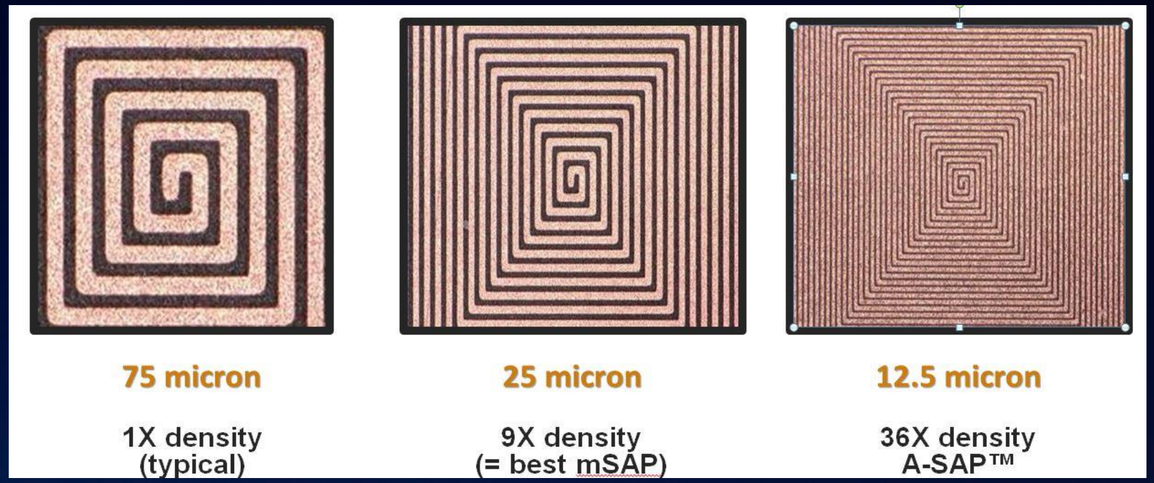
Additive Plate Up (A-SAP ™)

- Using Averatek Technology
- LMI™ Ink to deposit dense catalyst
- Licensed technology
- Easily adapted to sub 25 um
- Road to Package Substrates



American Standard Circuits
Sunstone Circuits

Ultra High Density at ASC

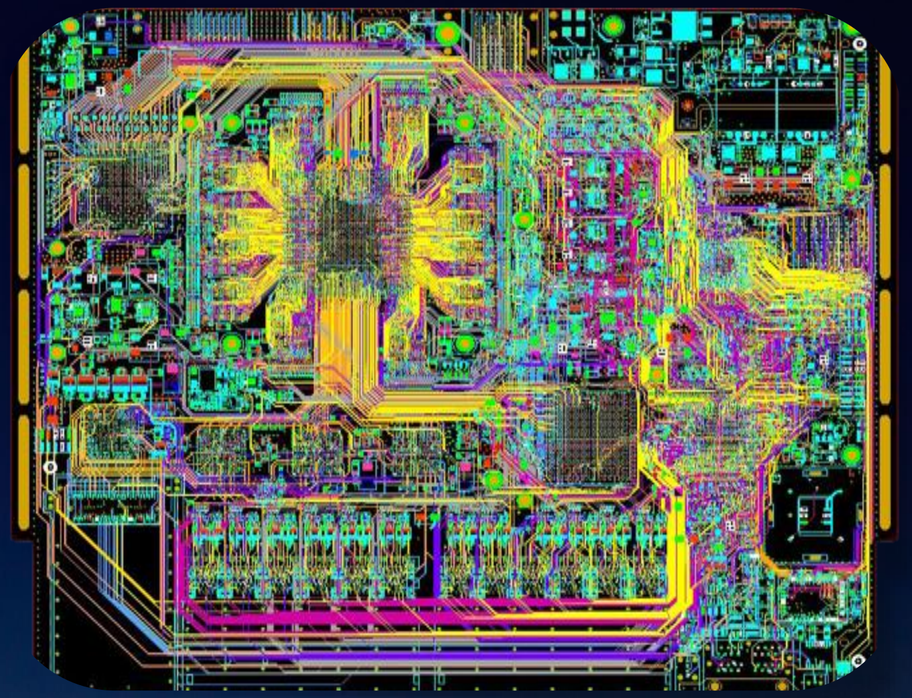


- 20 um lines (within 12 months will be down to 10 um)
- Also, ultra-thin foil processing for 25 um and above line technology
- 3 mil diameter hole size- copper filled microvias possible (2 mil and less in 12 months)
- Mixed Technology can be used in a board- subtractive tech can be used with ultra thin foils and/or A-SAP™ in the same board.
- Can be used on Flex, Rigid and Rigid-Flex with other key technology.

American Standard Circuits
Sunstone Circuits

SAP Advantages

- **Dramatic size and weight reduction** over current state-of-the-art
- **Improved Reliability:** reduced layer count, micro vias and lamination cycles
- **Improved Signal Integrity:** aspect ratios greater than 1:1 for metal traces
- **Improved RF performance** over traditional subtractive-etch process
- **Biocompatibility advantages:** Use gold as conductive metal



American Standard Circuits
Sunstone Circuits

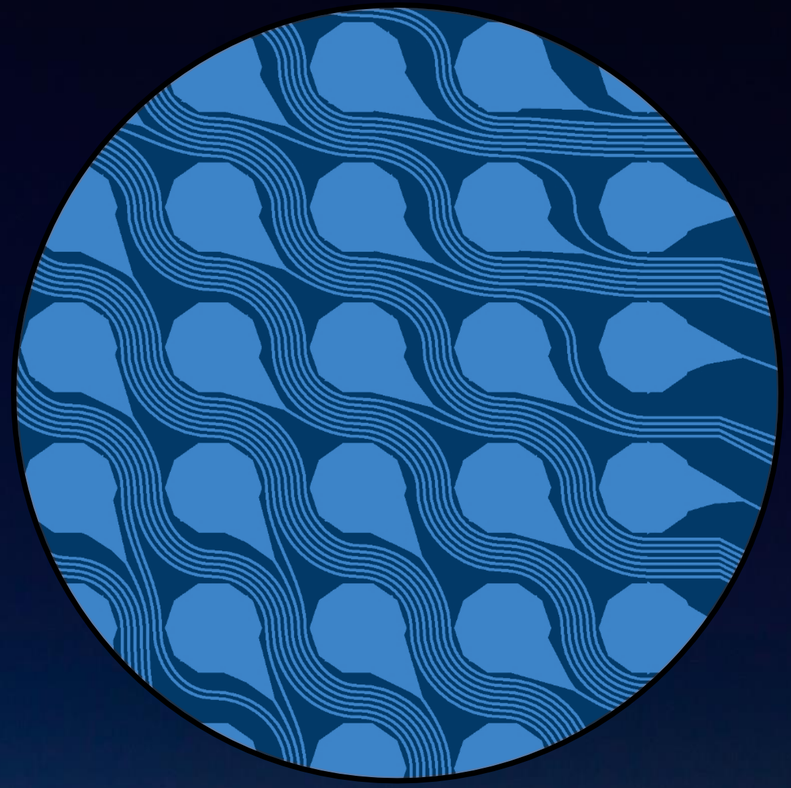
Circuit Density Improvement

- **Reduced Layer Count**
- **Improved Reliability**
- **Lower Costs**

Ball Pitch	Routing Layers Required	# of Traces between pads	Trace & Space (min feature size)
0.5 mm	**12**	**1**	**75 µm**
0.5 mm	**2**	**6**	**19 µm**

BGA* Grid 50x50

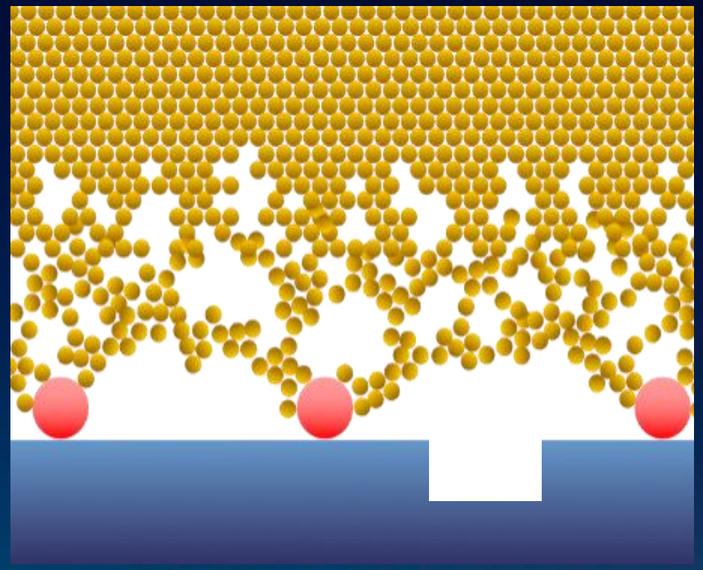
* For simplicity of analysis: assume all pads are signal pads



American Standard Circuits
Sunstone Circuits

LMI™ (Liquid Metal Ink)

Thin, Uniform and Dense Electroless Deposition

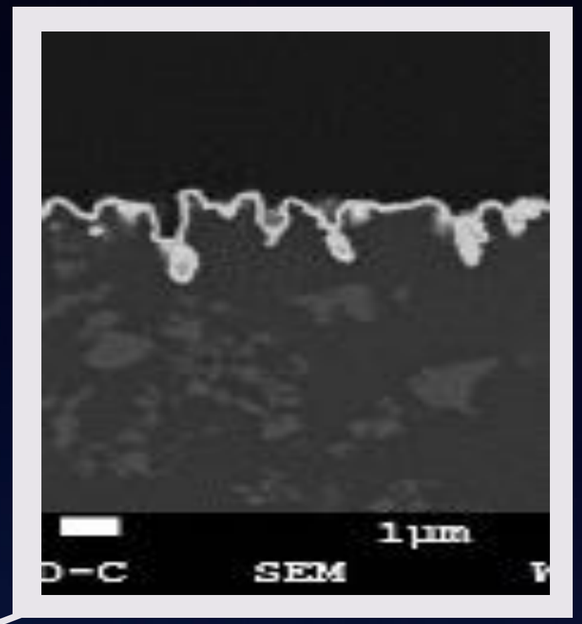


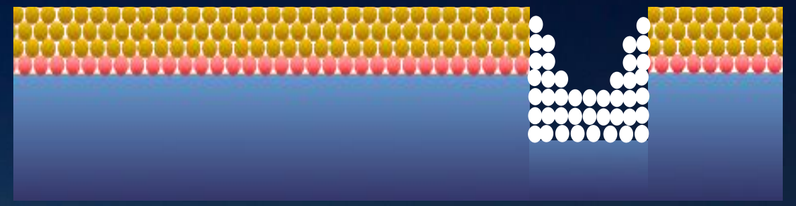
Standard Process

Copper

Palladium

Substrate

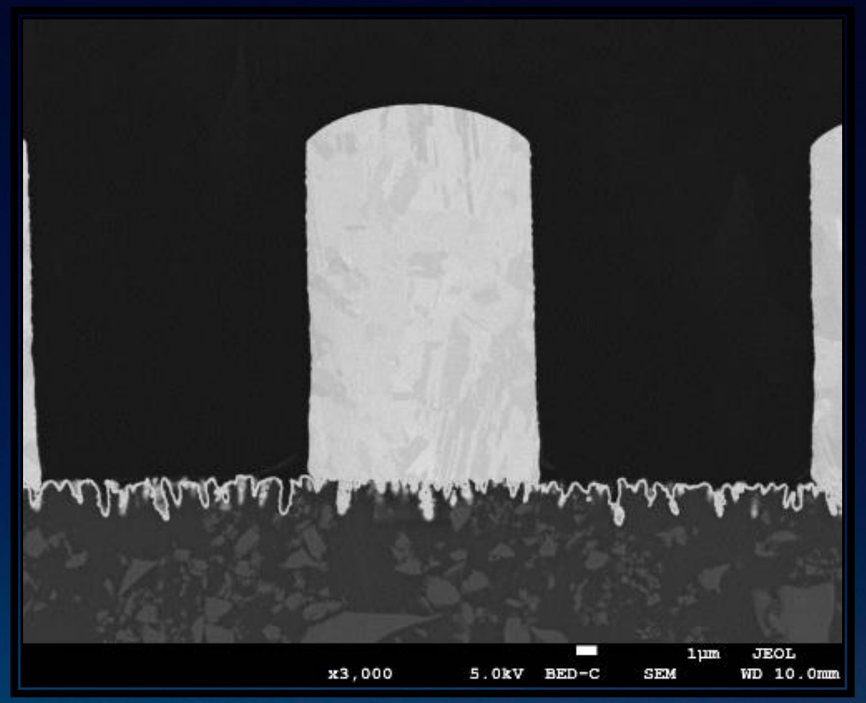




With LMI™

American Standard Circuits
Sunstone Circuits

Etching Very thin base copper ensures minimum etching impact



A-SAP™ - Before Etch

A-SAP™ After Etch

American Standard Circuits
Sunstone Circuits

Signal Integrity Advantages

11 µm wide copper traces on filled resin substrate.
LMI™ seed layer, pattern plated to 17 µm thick after flash etching.
(Image courtesy of MEC Corporation)

- **Vertical sidewalls and precise control of trace/space widths allows for much tighter control of impedance variations for RF**
- **High aspect ratio can reduce insertion loss and improve coupling of differential lines**
- **Narrow spacing improves inductive and capacitive coupling**
- **Allows use of very thin dielectrics**
- **Compatible with ultrahigh-speed, low-loss materials**

American Standard Circuits
Sunstone Circuits

A-SAP(TM) Compatible Materials

Type	Material	Manufacturer	Base Foil	Peel Strength (lb/in)
FR4	370 HR	Isola	RTF	4.6
	N4000-29	AGC MM	ACL™	4.6
	EM285 (HF)	EMC	ACL™	4.6
	EM370 (HF)	EMC	ACL™	3.2
Mid Loss	I-Speed	Isola	VLP2	3.5
	N4800-20	AGC MM	RTF	4.5
	EM526 (HF)	EMC	RTF	3.5
Low Loss	I-Tera MT40	Isola	VLP2	3.7
	TerraGreen	Isola	VLP2	4.6
	Megtron 6	Panasonic	HVLP	4.4
	RO4350	Rogers	LP RTF	5.3
	MW2000	AGC MM	VSP	6.3
	EM891	EMC	VSP	5.7

Type		Material	Manufacturer	Base Foil	Peel Strength (lb/in)
BT		N5000	AGC MM	STD	3.9
Flex	LCP	R-F705S	Panasonic	ED	5.8
		EXSYLAM -N	Ube Exsymo	ED	5.4
	Polyimide	Pyralux AP	DuPont	ED, ACL™	6-9
		Pyralux AG	DuPont	ED	≥ 6[a]
		Pyralux HT	DuPont	ACL™	≥ 6[a]
		R-F755	Panasonic	ED	7-9.5
		PIXEO	Kaneka	ED, ACL™	≥ 6[a]
	BU Film	UPISEL-N	Ube Exsymo	ED	6-8
		GX92	Ajinomoto	Desmear	4.2
		GL102	Ajinomoto	Desmear	2.6
		Zaristo125	Taiyo Ink	CBF™	3.6
		Zaristo500	Taiyo Ink	CBF™	3.9
		Zaristo700	Taiyo Ink	CBF™	6.5

Type	Material	Manufacturer	Base Foil	Peel Strength (lb/in)
Very Low Loss	Tachyon100G	Isola	VLP2	3.7
	Astra MT77	Isola	VLP2	4.6
	Megtron 7N	Panasonic	HVLP2	5.6
	MW4000	AGC MM	VSP	4.8
	MW8000	AGC MM	VSP	4.9
	EM890 (HF)	EMC	VSP	7.4
	CS3379M	Risho	VLP	6.5
PTFE	RO3003	Rogers	RA	≥15[a]
	CLTE-AT	Rogers	RA	≥15[a]
	FastRise TC	Taconic	Shiny side	4.3
	FastRise TC	Taconic	RTF	4.6
	EZ-IO F	Taconic	RA	5.0
	F220A	Nippon Pillar	VLP	9.7
	F300AS	Nippon Pillar	VLP	9.2

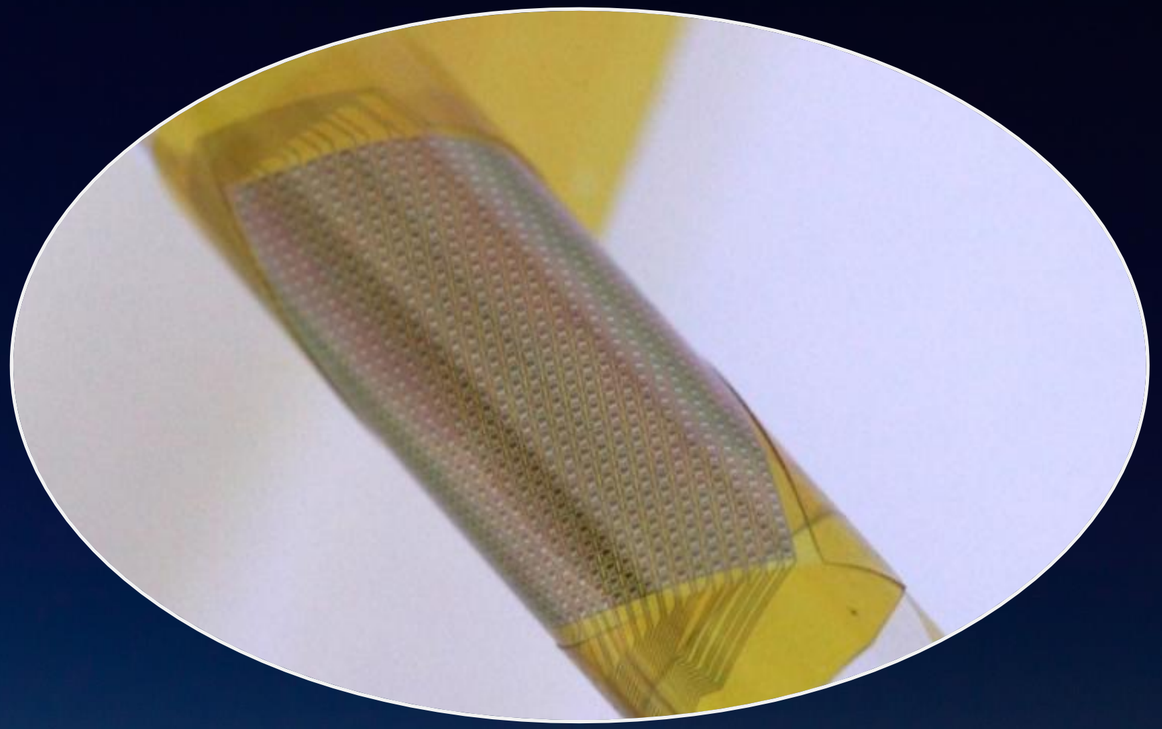
a: The base laminate was destroyed during the peel strength test. Base foil provides the same roughness to the circuit.

- All data are collected from lab tests at Averatek

American Standard Circuits
Sunstone Circuits

A-SAP™ Biocompatibility Advantages

- Gold, palladium, platinum or any combination of these metals used as conductors
- LCP or Polyimide for dielectrics
- For neural probes, glucose monitoring and other implantable devices



American Standard Circuits
Sunstone Circuits

UHDI Technology at ASC
LCP Medical Partnership

Agreement with LCP Medical for Patented LCP Multilayer Technology

- New material processing technology for Liquid Crystal Polymers (LCP)
- Joint Marketing and Manufacturing Program
- Technical Transfer for use of LCP’s Patented Multilayer processing
- Existing Customer demand from - RF, Defense & Medical

American Standard Circuits
Sunstone Circuits

UHDI Technology at ASC

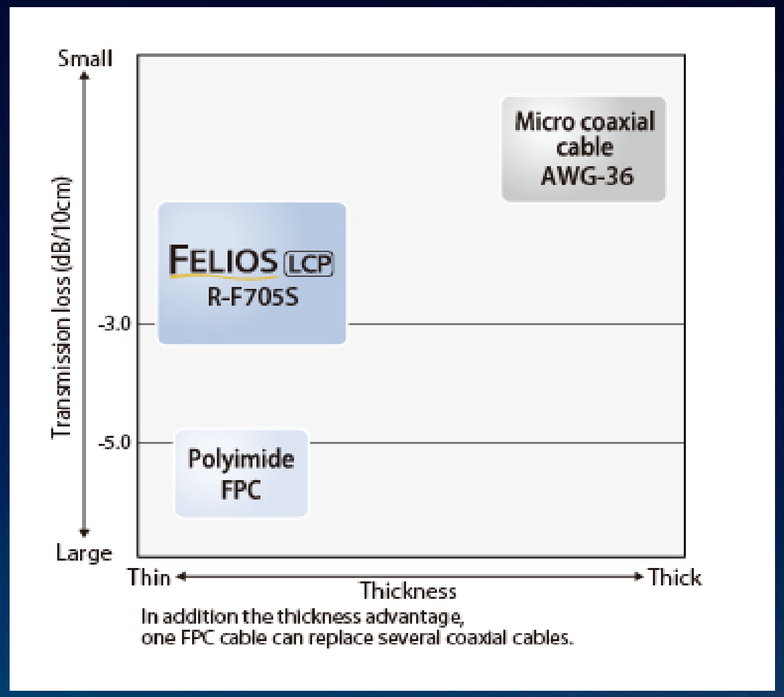
What is Liquid Crystal Polymer (LCP)

Agreement with LCP Medical for Patented LCP Multilayer Technology

- Thermoplastic material (aromatic polyester) – Melts ~ 315^0 C (600^0 F)
- Low Dk / Df (2.9 / 0.002 at 14 GHz) & Low water absorption (0.04%)
- Material available in 1 to 6 mils in 1 mil increments with 9, 12 & 18 um copper foils.
- Can be made into multilayer structures using LCP Medical patented technology.
- Avionics/Space applications, Smartphone(FPC Antenna(LTE, WiFi), LCD module), Laptop, Tablet PC, 4K/8K display (High-speed FPC cable), Antenna(Base station, Automotive millimeter-wave radar), etc.
- Customer applications: Benchmark (Filters), Lockheed, Motorola, Intel, Mercury

UHDI Technology at ASC

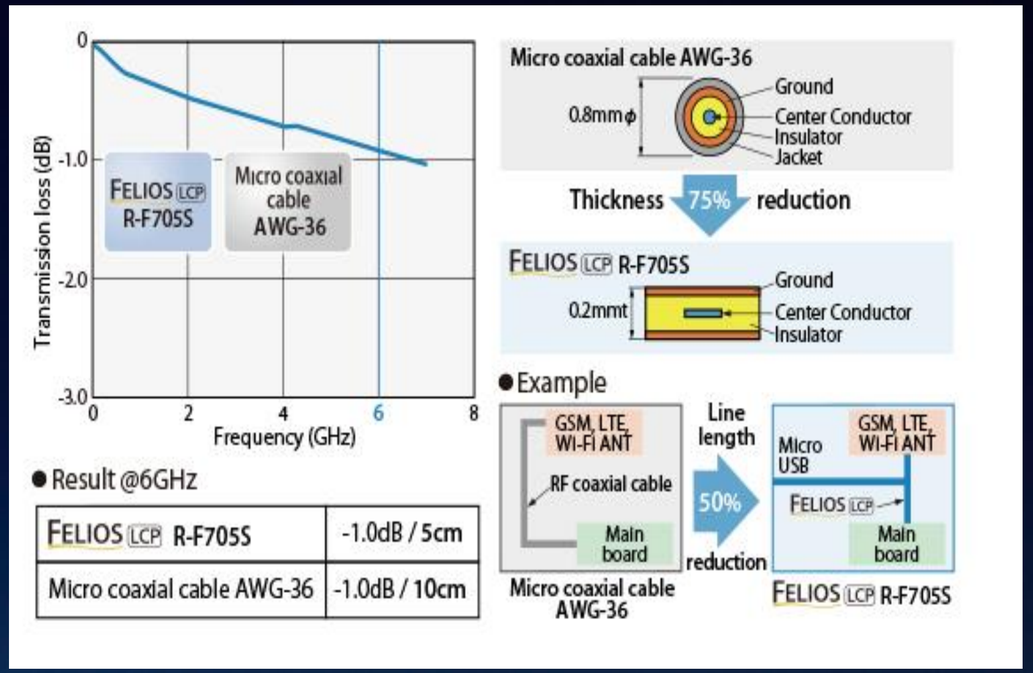
LCP vs Flex Polyimide vs Micro Coax Cables



LCP has much lower loss than Flex Polyimide.

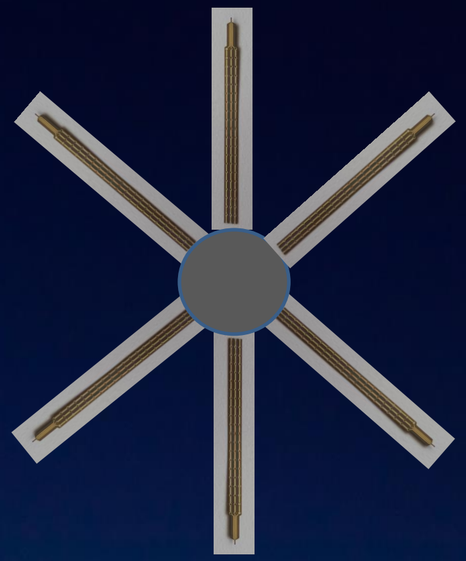
Also, it can match the performance of a Micro coax cable at half of the thickness

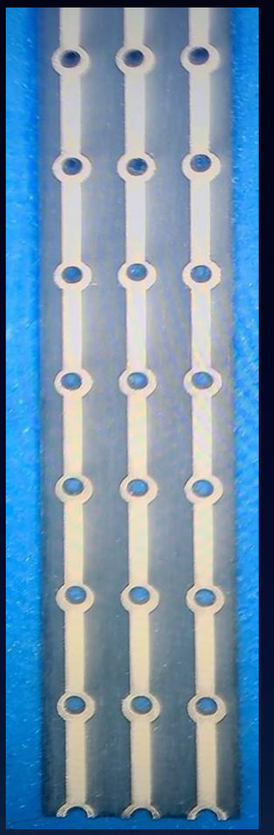
Or… it can beat the coax in thickness and loss with shorter line lengths



American Standard Circuits
Sunstone Circuits

Medical Flex Circuit

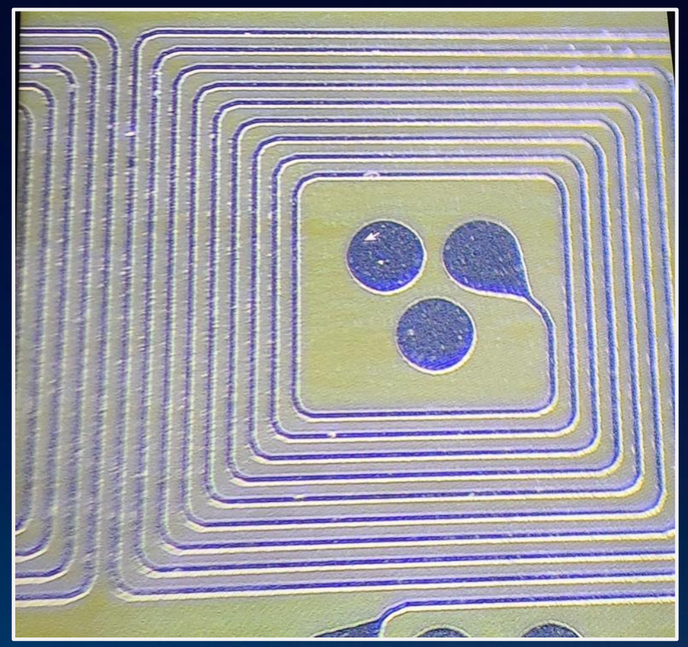


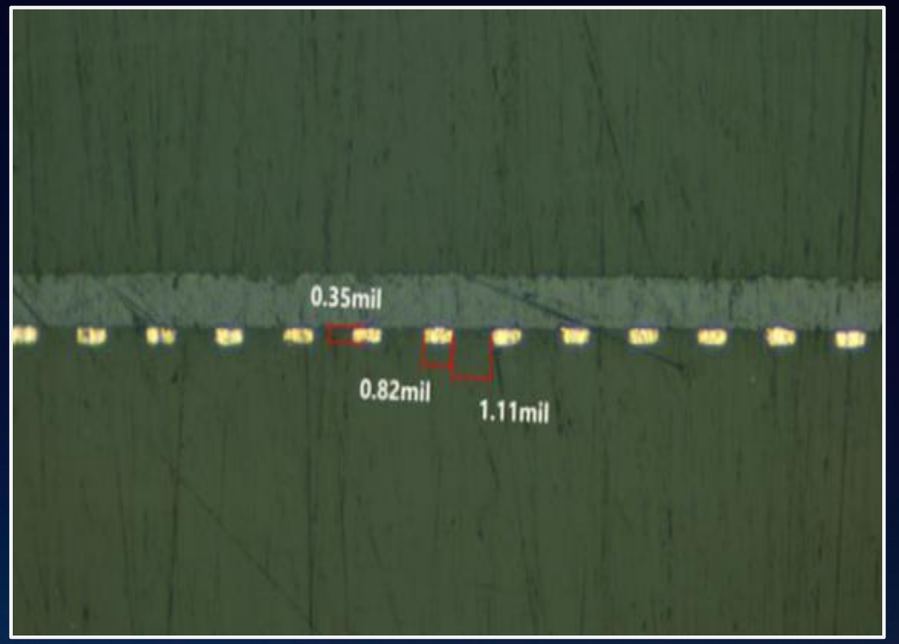


4 mil thick Polyimide Flex with 25 um lines and gold finish

American Standard Circuits
Sunstone Circuits

Flex Circuit for Specialty Tester





25 um thick Polyimide Flex with 20 um lines

American Standard Circuits
Sunstone Circuits

SUNSTONE PRODUCT CAPABILITIES

- Digital PCB
- Designs with up to 14 layers in one day
- Expedited 2-day turnaround available up to 20 layers
- Materials available: Rogers, Taconic, Polyflon
- Single lamination process utilized
- Precise management of controlled impedence

American Standard Circuits
Sunstone Circuits

FREE RESOURCES
FROM ASC/SUNSTONE

WEBINARS
Attend free webinars focused on different PCB topics

eBOOKS
Download concise and relevant books written by the ASC/Sunstone experts

EXPERTS BLOG
The ASC Experts help you learn more about advanced PCB technologies

ONLINE DFM
Upload Gerber files and get results back in just 60 minutes

American Standard Circuits
Sunstone Circuits

CERTIFICATIONS

- **AS9100D/ISO 9001:2015**
- **ISO13485:2016 Medical**
- **MIL-PRF-31032 Certified**
  -FR4, Polyimide, Flex, Rigid-Flex, Pure Hydrocarbon, Hydrocarbon Hybrid
- **MIL-PRF-55110 Appendix B**
- **MIL-PRF-50884F**
- **IATF16949:2016**
- **ITAR Registered**
- **US / Canada Joint Certification Program 0042522**
- **ASC Conforms with DFARS**
- **252.204-7012 (NIST 800-171)**
- **UL Certified File:**
  -ZPMV2.E95201
  -ZPXK2.E474323
  -ZPMV8.E95201

American Standard Circuits
Sunstone Circuits

COMPETITIVE PRICING / ACCELERATED LEAD TIMES

Single Sided, Double Sided & Multi-Layer FR-4 PCBs

In-House Fabrication of Prototype, Medium & Volume Production

Quick Turn Lead Times

24 Hours - 10 day for protos/low volume
3-10 day metal backed PCBs/Flex

Standard Delivery

15 days standard delivery
20-25 days advanced technologies
20-35 days metal day backed PCBs

Partners in Low-Cost Regions

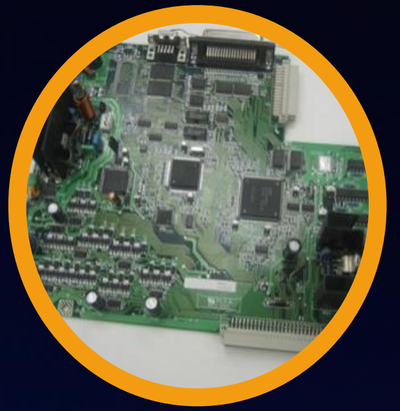
Stocking programs available to reduce/minimize lead times

American Standard Circuits
Sunstone Circuits

Global Sourcing & Supply Chain Services







Bob Duke
President of Global Sourcing Division
~40 Years PCB Experience

~Past President M-Wave International LLC and MWI Supply Chain Services

~Past VP/GM Viktron Technologies

Grace Liu
Quality Manager
~20 Years PCB Quality Experience

~Located in Southern China

Pauline She
Supply Chain Manager
~10+ Years PCB Experience

~Located in Central China

Roy Rong
QC/Sourcing Coordinator
~18+ Years Quallity/Supply Chain

~Previously Employed - Golden Gain/M-Wave International LLC (Supply Chain Services)

~Located in Southern China

American Standard Circuits
Sunstone Circuits

Global Sourcing & Supply Chain Services

- 15+ Years of Experience
- Diverse Product Offering
- Strong Stable Supply Base
- Technical Support
- Financially Stable
- Value-Added Services
- Feet on the Ground in Asia
- Local Warehousing

American Standard Circuits
Sunstone Circuits

GLOBAL SOURCING
PRODUCT OFFERING

- PCBs - All types, Prototype/Production
- Plastic Fabrication - Injection, Vacuum, Over and Blow Molding
- Metal Fabrication - Stamping, Die Casting, Extrusion, Laser Cutting, Spinning and CNC Machining
- Batteries - Lithium-Ion, Lithium Polymer and GEL
- Magnetics - All Types of Transformers and Coils
- Wire Harnesses and Cable Assembly
- Mechanical Assembly
- Membrane Switches and Graphic Overlays
- Speakers
- and more...

American Standard Circuits
Sunstone Circuits

OFF-SHORE PCB MODEL

North America based Customer Service & Engineering

Seamless transition from proto-type to volume production

- No second charge for tooling

Partners

- Match Customer needs with partner capability

20+ Years of Experience managing off-shore transitions

Risk Mitigation

- Domestically manufacture most products for quick recovery if needed
- Inspect parts, cross-sections and first article reports generated at ASC to validate quality of outgoing parts

On Site Support in China - Logistics / Quality

American Standard Circuits
Sunstone Circuits

DIVERSE END MARKETS

American Standard Circuits
Sunstone Circuits

Defense/Aerospace

L3HARRIS™
MACOM
BAE SYSTEMS
NORTHROP GRUMMAN
CAES
PIONEERING ADVANCED ELECTRONICS
MOTOROLA SOLUTIONS
SIERRA SPACE
Raytheon An RTX Business
LOCKHEED MARTIN

Automotive/Industrial

SWITCH-PROS
ZF
PANDUIT
Basler Electric
veoneer
MSD
VANCE & HINES
cpi
Hendrick MOTORSPORTS

LED

adec reliablecreativesolutions
CREE
OSRAM
Dialight
USHIO
J.W. SPEAKER Engineered. Lighting. Solutions.

ACTIVE CUSTOMERS

Communications

ACACIA + cisco
COMTECH POWER SYSTEMS TECHNOLOGY
facebook
GATESAIR
WERLATONE
Google
EMPOWER RF SYSTEMS, INC.
AFL

Medical

PARKS
AxoSim
Abbott
KINOVA ROBOTICS
MERIT MEDICAL
CardinalHealth
OSTEOMED
Synaptic MEDICAL
St. Jude Children's Research Hospital
Boston Scientific
GLOBUS MEDICAL
Cirtec MEDICAL GMBH
Baxter
TELEDYNE SCIENTIFIC & IMAGING
PHILIPS RESPIRONICS
stryker
fisher scientific
SwRI
SOUTHWEST RESEARCH INSTITUTE
SRS MEDICAL

Contract Mfgs

Milwaukee Electronics
4FRONT SOLUTIONS
ZENTECH
SMTC MANUFACTURING INNOVATORS
STIM ELECTRONICS MANUFACTURING
IPS ASSEMBLY
Amphenol BORISCH TECHNOLOGIES
SANMINA - SCI

American Standard Circuits
Sunstone Circuits

CONTINUAL IMPROVEMENT

Quality

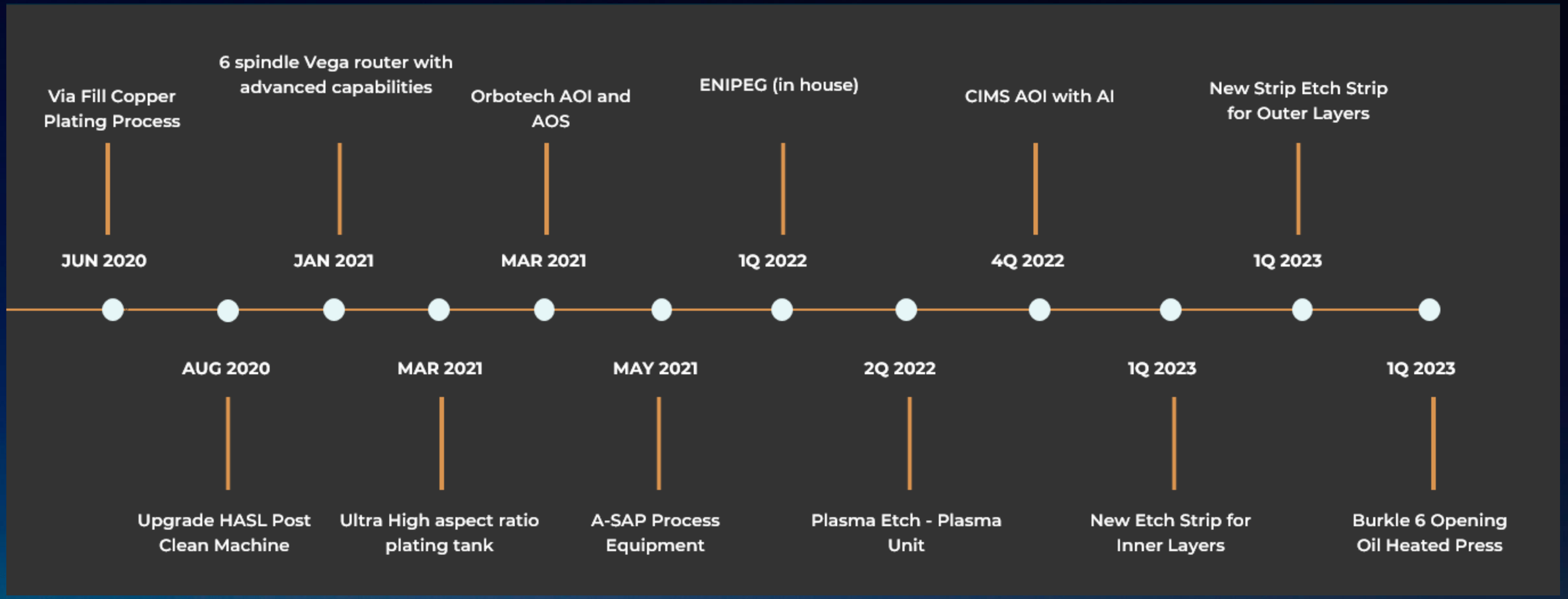
- TrueChem - 2015
- New CMM for metal-backed PCBs - 2015
- MIL-PRF-31032 for Hydrocarbon Ceramic Pure-build/Hybrid - 2015
- Quality Manager Certified IPC-6012 Trainer
- AS9100C Certificaiton - 2016
- Electronic Record Retention System - 2017
- Upgraded Certification to AS9100D/ISO 2015 - 2017
- MIL-PRF-31032 Approval for Flex/Rigid-Flex - 2017
- Digital X-Ray System 80KV - 2019
- IATF Certification - 2019
- New CMM for PCB Measurements - 2019
- New Advanced XRF Unit - 2019
- Metalwork laser marking - 2019
- Upgraded TDR Tester - 2019
- Upgrade Cross-section Equipment - 2020
- Upgraded AA & CVS Unit - 2022
- ISO 13485-2016 Certification - 2023

Engineering

- 50% Increase in engineering capacity - 2015
- Orbotech Gen Flex Implementation - 2015
- Orbotech Inplan rules based traveler - 2016
- X-Act Software for Registration Scaling Modeling - 2017
- Scripting for improved quality/speed - 2018 ingoing
- X-Act Flex Implemented - 2019
- X-Act Integration with Smart Parts for annualar ring check prior to drilling - 2022

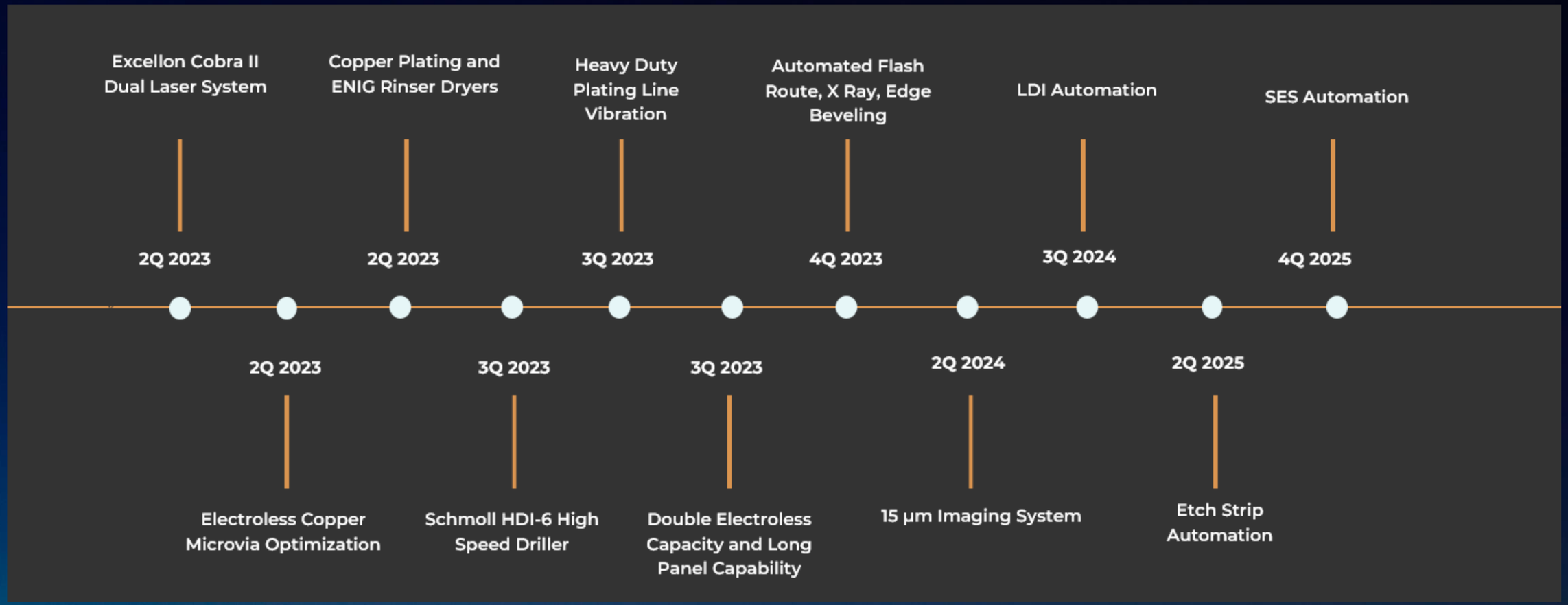
American Standard Circuits
Sunstone Circuits

EQUIPMENT UPGRADE ROADMAP



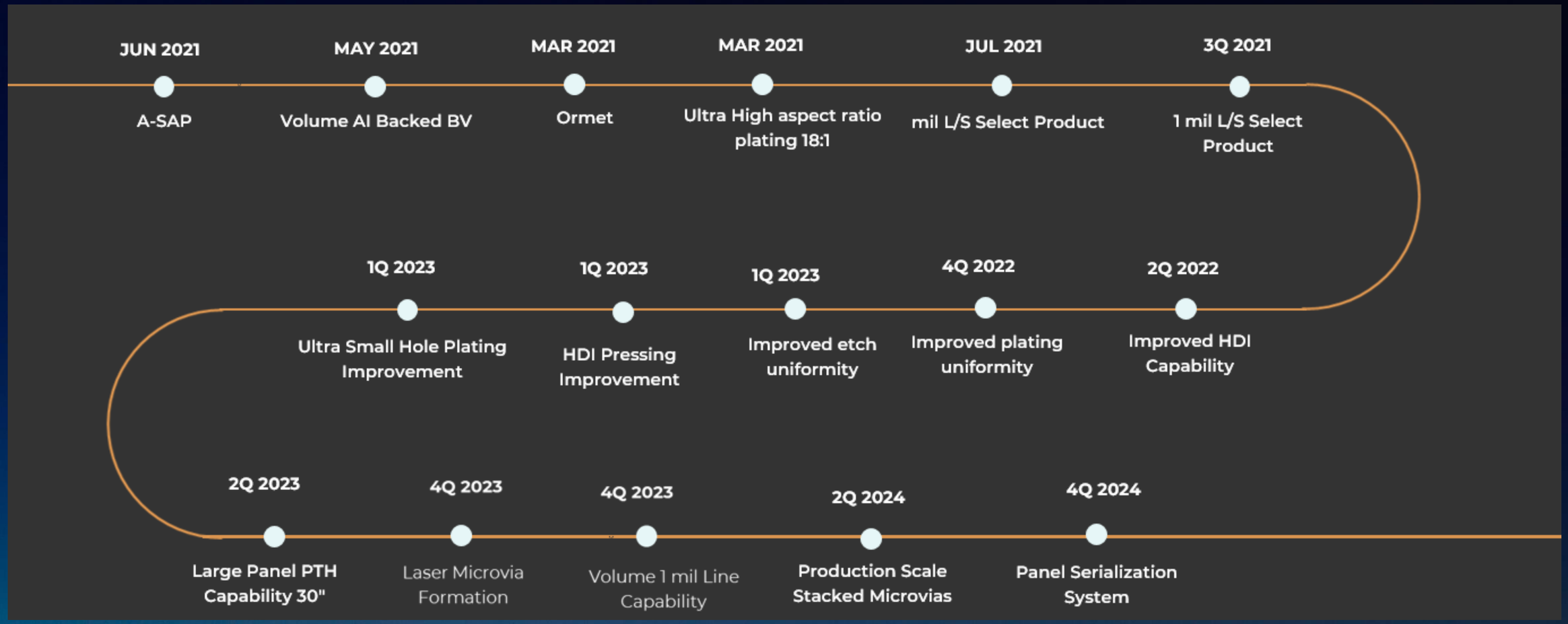
American Standard Circuits
Sunstone Circuits

EQUIPMENT UPGRADE ROADMAP



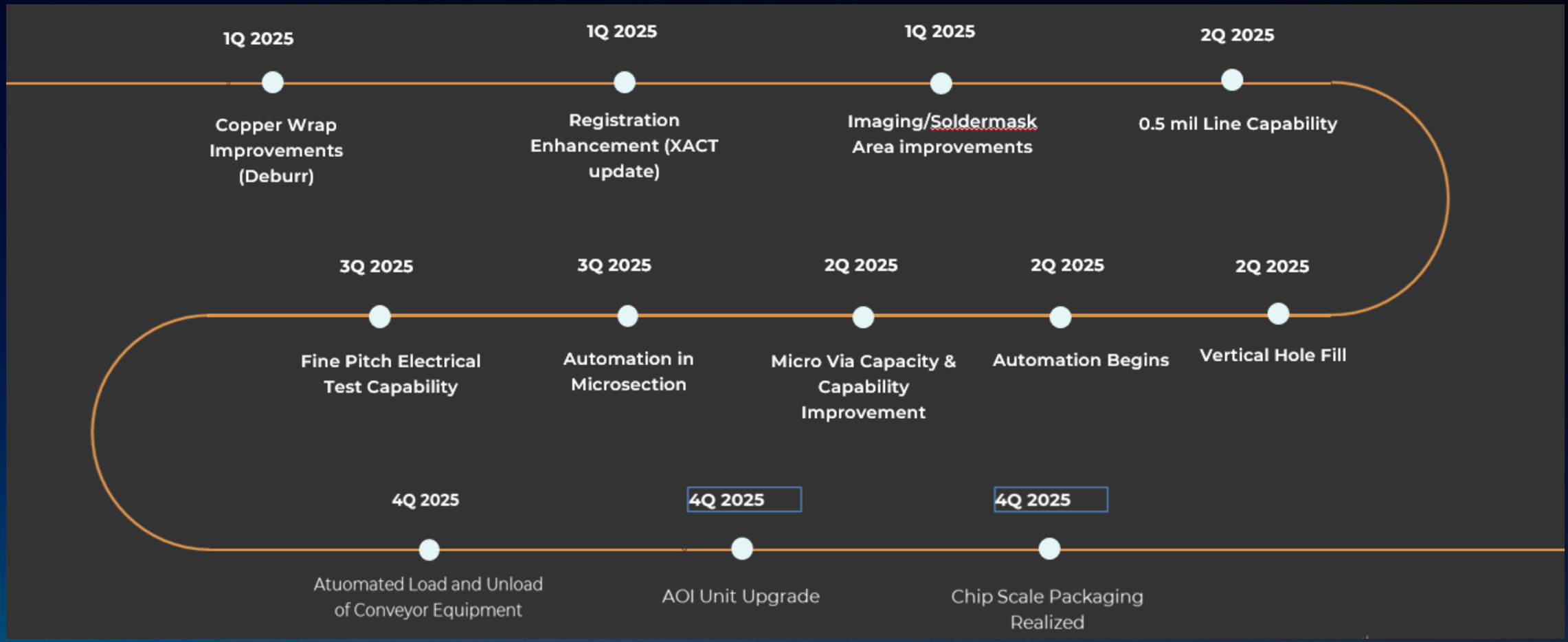
American Standard Circuits
Sunstone Circuits

TECHNOLOGY ROADMAP



American Standard Circuits
Sunstone Circuits

TECHNOLOGY ROADMAP



American Standard Circuits
Sunstone Circuits

THANK YOU.

American Standard Circuits
475 Industrial Dr.
West Chicago, IL 60185
PH: 630-639-5444
sales@asc-i.com
www.asc-i.com

Sunstone Circuits
13626 S. Freeman Rd
Mulino, OR 97042
PH: 503-829-9109
support@sunstone.com
www.sunstone.com

American Standard Circuits
Sunstone Circuits