Flexible Hybrid Electronics North America TC Chapter

Meeting Summary and Minutes

SEMI Standards NA Spring Meetings 2025

Tuesday, April 29, 2025

08:00 – 10:00 Pacific

Virtual via Official Virtual TC Chapter Meeting (OVTCCM)

TC Chapter Announcements

Next TC Chapter Meeting

SEMICON West 2025

Thursday, October 9, 09:00 – 12:00 Noon Mountain

Phoenix Convention Center, Phoenix, Arizona/USA

Table 1 Meeting Attendees

Co-Chairs: Randall Parker (ASI), Ahmed Busnaina (Northeastern University)
SEMI Staff: Laura Nguyen, Paul Trio

Company	*Last*	*First*	*Company*	*Last*	*First*
Auburn University	*Lall*	*Pradeep*	SEMI	Nguyen	Laura
Binghamton University	*Gonya*	*Steve*	SEMI	Ozturkler	Basak Ulutas
DISCO Hi-Tec America	*Parker*	*Randall*	SEMI	Samadi	Gity
ChemCubed	*Slep*	*Dan*	SEMI	Semenza	Paul
GE Aerospace, US	*Trivedi*	*Deepak*	SEMI	Trio	Paul

Table 2 Leadership Changes

None

Table 3 Committee Structure Changes

None

Table 4 Ballot Results

Document #	*Document Title*	*TC Chapter Action*	*A&R Forms for Approved Ballots*
7193	New Standard: Guide For Substrate Design Of Flexible Hybrid Electronics	**Failed**	

NOTE 1: **Passed** ballots and line items will be submitted to the ISC Audit & Review Subcommittee for procedural review.
NOTE 2: **Failed** ballots and line items were returned to the originating task forces for re-work and re-balloting or abandoning.

Table 5 Activities Approved by the GCS between meetings of the TC Chapter

#	*Type*	*SC/TF/WG*	*Details*
7193	Ballot Authorization	FHE Design TF	New Standard: Guide for Substrate and Interconnect Design of Flexible Hybrid Electronics ***– Approved for Cycle 2-2025, by GCS on 01/27/2025***

Table 6 Authorized Activities

Listing of all revised or new SNARF(s) approved by the Originating TC Chapter.

None

Table 7 Authorized Ballots

Listing of documents authorized by the Originating TC Chapter for Letter Ballot.

#	*When*	*TF*	*Details*
7193	Cycle 7, 2025	FHE Design TF	New Standard: Guide for Substrate and Interconnect Design of Flexible Hybrid Electronics

Table 8 SNARF(s) Granted a One-Year Extension

None

Table 9 SNARF(s) Canceled

None

Table 10 Standard(s) to receive Inactive Status

None

Table 11 New Action Items

None

Table 12 Previous Meeting Action Items

None

1 Welcome, Reminders, and Introductions

Randall Parker (ASI), called the meeting to order at 08:00 Pacific. The meeting reminders on antitrust issues, intellectual property issues and holding meetings with international attendance were reviewed. Attendees introduced themselves.

Attachment: SEMI Standards Required Elements (File name: Required Meeting Elements)

2 Review of Previous Meeting Minutes

The TC Chapter reviewed the minutes of the previous meeting.

Motion:	To accept the previous meeting minutes as written.
By / 2nd:	By: Daniel Slep / ChemCubed Second: Stephen Gonya / Binghamton University
Discussion:	None
Vote:	3-0 in favor. Motion passed.

Attachment: [2023Sept] FHE NA TC Chapter Meeting Minutes draft

3 Liaison Reports

3.1 *Flexible Hybrid Electronics Taiwan TC Chapter*

Laura Nguyen (SEMI HQ) reported for the Taiwan TC Chapter. Of note:

Meeting Information

- Last meeting: March. 26, 2025, 14:00 – 16:00, Web Meeting, Taiwan.
- Next meeting: TBD

TC Chapter Leadership *(Refer to attachment for Org Chart)*

- Co-chairs: Steve Huang/ AIQ, YE Yeh/ ASE

Ballot Results: None

Authorized Activities

- SNARF for Local Area Sensing Network for FHE System Task Force
    - New SNARF was discussed by TC members in FHE Taiwan TC Meeting on Mar. 26, 2025
    - New SNARF proposal will be sent out for 2 weeks review by Global FHE TC member.
    - After 2 weeks review, the SNARF will be sent to FHE GCS Members for approval.

Staff Contact: Cheryl Chuang, cchuang@semi.org

Attachment: Liaison Report_FHE Taiwan_20250326_R1_LNN

3.2 *Flexible Hybrid Electronics Japan TC Chapter*

Laura Nguyen (SEMI HQ) reported for the Japan TC Chapter. Of note:

Meeting Information

- Last meeting: Friday, January 31, 2025, SEMI Japan Office + OVTCCM (Hybrid)
- Next meeting: Friday, May 30, 2025, SEMI Japan Office + OVTCCM (Hybrid)

TC Chapter Leadership *{Refer to attachment for Org Chart}*

- Co-chairs: Satoshi Maeda/ TOYOBO, Ryoichi Watanabe/ Japan Display Inc., Tadahiro Furukawa/ Yamagata University

Ballot Results: None

Authorized Ballots

- 6906, New Standard: *Terminology for Flexible Hybrid Electronics*

Other Activities Outside the Letter Ballot Process

- FHE4-0724, Test Method and Guide for the Tactile Characteristics of Flexible Hybrid Electronics Materials and Products *[Unballoted editorial changes]*
    - Passed

Task Force Highlights

- FHE Terminology Task Force
    - Co-Leaders: Satoshi Maeda (TOYOBO), Ryoichi Watanabe (Japan Display Inc.), Tadahiro Furukawa (Yamagata University)
    - The TF has been discussing what kind of standards are necessary to be developed while drafting Terminology standard.
    - Doc.#6906, New Standard: Terminology for Flexible Hybrid Electronics, will be submitted for Cycle 3, 2025
- Tactile Texture Characteristics for FHE Task Force
    - Co-Leaders: Mari Inoue (Kobe University), Satoshi Maeda (TOYOBO), Tadahiro Furukawa (Yamagata University)
    - Doc.#6978, New Standard: Test Method for The Tactile Texture Characteristics of FHE Materials And Products, was published as FH4-0724.
    - Upon its publication, Type 2 Editorial change was proposed through Publication Change Request (PCR) to clarify the technical meaning.
        - Passed the TC Chapter review and the following ISC A&R SC procedural review.
        - Waiting for its publication.
    - TF was designated as dormant by the TC Chapter on January 31, 2025.
        - TF completed all the projects, but decided to keep the TF for possible future activities.
- Flexible Hybrid Electronic (FHE) Maintenance Task Force
    - Co-Leaders: Tadahiro Furukawa (Yamagata University), Ryoichi Watanabe (Japan Display Inc.)
- This TF was formed in July, 2024 to conduct following activities:
    - Maintenance
        - 5-Year review document
        - Improvement of readability to prevent misreading
        - Improvement of cross reference capability
    - Ballot review
    - Roadmap discussion
- Ballot review meeting regarding Doc.#7193 was held on March 4th.

Staff Contact: Nahoko Koga, nkoga@semi.org

Attachment: Liaison Report_FHE Japan TC Chapter_March 2025_R1_LNN

3.3 *SEMI Staff Report*

Laura Nguyen (SEMI) gave the SEMI Staff Report. Of note:

SEMI Global 2025 Calendar of Events

- SEMICON China (March 26-28; Shanghai)
- SEMICON SEA (May 20-22; Singapore)
- SEMICON India (Sept 1-3; New Delhi, India)
- SEMICON Taiwan (Sept 10-12; Taipei, Taiwan)

- SEMCON West (Oct 7-9; Phoenix, Arizona)
- SEMICON Europa (Nov 18-21; Munich, Germany)
- SEMICON Japan (December 17-19; Tokyo, Japan)

SEMICON West 2025-2030 ← **NEW!**

- **2025—October 7-9 | Phoenix Convention Center | Phoenix, AZ**
- 2026—October 13-15 | Moscone Center | San Francisco, CA
- **2027—October 12-14 | Phoenix Convention Center | Phoenix, AZ**
- 2028—October 10-12 | Moscone Center | San Francisco, CA
- **2029—October 9-11 | Phoenix Convention Center | Phoenix, AZ**
- 2030—October 29-31 | Moscone Center | San Francisco, CA

Upcoming NA Meetings 2025

- NA Standards Summer Meetings: June 2-5, 2025, at SEMI HQ, Milpitas, California/USA
- SEMICON West: Oct 6-9, 2025, at Phoenix Convention Center, Phoenix, Arizona/USA

Critical Dates for SEMI Standards Ballots

- Cycle 2-2025: Ballot Submission Due: Jan 23/Voting Period: Feb 11 – Mar 13
- Cycle 3-2025: Ballot Submission Due: Mar 5/Voting Period: Mar 19 – Apr 18
- Cycle 4-2025: Ballot Submission Due: Mar 20/Voting Period: Apr 9 – May 9
- Cycle 5-2025: Ballot Submission Due: May 8/Voting Period: May 28 – June 27
- Cycle 6-2025: Ballot Submission Due: June 19/Voting Period: July 9 – Aug 8
- Cycle 7-2025: Ballot Submission Due: July 24/Voting Period: Aug 13 – Sep 12
- Cycle 8-2025: Ballot Submission Due: Sept 3/Voting Period: Sept 24 – Oct 24
- Cycle 9-2025: Ballot Submission Due: Oct 1/Voting Period: Oct 21 – Nov 20

https://www.semi.org/en/collaborate/standards/ballots

Standards Publications Report

Cycle	*New*	*Revised*	*Reapproved*	*Withdrawn*
November 2024	2	0	0	0
December 2024	0	11	6	0
January 2025	3	2	4	0

Total in portfolio – 1,098 (includes 356 Inactive Standards)

New Standards

Cycle	*Designation*	*Title*	*Committee*	*Region*
November 2024	SEMI E190	Specification for Equipment Data Publication (EDP)	Information & Control	NA
November 2024	SEMI E190.1	Specification for Common Data for Etch Components	Information & Control	NA
January 2025	SEMI E192	Guide for Equipment Adoption Criteria for GEM and GEM-related Standards	Information & Control	NA
January 2025	SEMI D87	Test Method for Response Time Evaluation of Displays with Variable Refresh Rate	FPD – Metrology	KO
January 2025	SEMI PV102	Guide for Tube PECVD Graphite Boat Materials for Solar Cell Production	Photovoltaic	CH

Connect@SEMI Communities for all SEMI Standards Task Forces *{update}*

- By Feb 2025, all Standards Task Forces shall use Connect@SEMI to host documents that are currently in development.
  - **The ISC Regulations SC recommends to postpone enforcement of implementation until next Regs/PM revision (which is currently aimed to become effective by NA Summer meeting in June)**
  - **Regs SC is working with SEMI to Update both Connect@SEMI and rules so that they are aligned each other**
- Each Standards Task Force will have its own Community Page on Connect@SEMI.
- All program members may log in at: https://connect.semi.org (username and password is same as program membership log-in)

Staff Contact: Laura Nguyen, Lnguyen@semi.org

Attachment: Staff Report Feb 2025 v3_FHE

4 Ballot Review

NOTE 1: TC Chapter adjudication on ballots reviewed is detailed in the Audits & Review (A&R) Subcommittee Forms for procedural review. The A&R forms are available as attachments to these minutes. The attachment file name for each balloted document is provided under each ballot review section below.

4.1 Document # 7193, New Standard: Guide for Substrate Design of Flexible Hybrid Electronics

- The committee found the negative related and technically persuasive. The ballot failed and returned to the task force for re-work and re-ballot.

Motion:	Negative from **Satoshi Maeda / University of Tokyo Negative#** is related and persuasive.
By / 2nd:	By: Stephen Gonya / Binghamton University Second: Daniel Slep / ChemCubed
Discussion:	None
Vote:	4-0 in favor. Motion passed.

Motion:	This Document failed TC Chapter review and will be returned to the TF for rework.
By / 2nd:	By: Pradeep Lall / Auburn University Second: Stephen Gonya / Binghamton University
Discussion:	None
Vote:	4-0 in favor. Motion passed.

Attachment: 02-25-Flexible Hybrid Electronics

5 Task Force Reports

5.1 *FHE Design*

Steve Gonya (BU) presented for this activity. Of note:

- Leadership: Deepak Trivedi (GE), Steve Gonya (BU)
- Charter: Create an FHE design guideline pertaining to design rules and best practices for substrates, circuit patterns, interconnects, and flexibility/stretchability considerations
- We have submitted SEMI Draft Document 7193 "Guide for Substrate Design of Flexible Hybrid Electronics" for Letter Ballot Cycle-2-2025
  - Ballot Results: 37 Accept, 7 Reject, 2 Accept with comments
  - SEMI FHE Design TF plans to ask TC to fail 7193 document at April 29 Chapter Meeting
  - Plan to edit 7193 document and re-ballot in Cycle-7-2025, submission date Thu July 24
- Summary of Ballot Cycle-2-2025 Reject Comments

- We anticipated that Cycle-2 ballot would be rejected because of some unfinished content, but wanted to get initial feedback to incorporate and finish document for Cycle-7 re-ballot
- Most of the reject comments were related to known missing content and clarifications in wording, figure sourcing, or document scope. For example;
    - E-Textiles is not within document scope and will be clarified in title and limitations
    - Restructure document to eliminate content overlap and improve readability
    - Inconsistent terminology, definitions, descriptions, and units
    - Terminology must be consistent with SEMI document 6906
    - Update figures and address copyright and trademark issues
    - Recommendations on content that should be added or deleted
- Ballot Authorization(s):

Motion:	Authorize Document 7193 for Letter Ballot in Cycle 7, 2025
By / 2nd:	By: Stephen Gonya / Binghamton University Second: Daniel Slep / ChemCubed
Discussion:	None.
Vote:	4-0 in favor. Motion passed.

Attachment: FHE-TF-Reports_April29

5.2 *FHE Inks Characterization*

Daniel Slep (ChemCubed) presented for this activity. Of note:

- Leadership: Kurt Christenson (Optomec), Ahmed Busnaina (Northeastern University), Dan Slep (ChemCubed)
- Charter: The Inks TF will focus on standards for incoming inks along with a small of immediately post-process tests.
- SNARF 7212: Guide for Inks Characterization for Flexible Hybrid Electronics
- Scope of the Document: This Standard provides guidance on established tests to develop methods that pertain to reliability and testing of incoming inks. Inks in this Guide refer to all incoming printable materials, such as screen-printing pastes and ink jet inks.
- This Guide will account for:
    - Analytical methods and instruments
    - Liquid ink testing (e.g., shear, extensional, shear thinning viscosity, mass/volume output, surface tension, contact angle, solids fraction, metals fraction, particle/flake size distribution, appearance)
    - Printability (e.g., ink jet, e-jet, DoD jet, aerosol jet, pen, direct assembly, screen, gravure)
    - Post process (e.g., dry, sinter, cure)
- Topics to Consider *{refer to attachment for images}*
    - Liquid Ink Testing, Printing, Post process, Printed Ink Testing
    - The Inks TF will focus on standards for incoming inks along with a small of immediately post-process tests.
- Update
    - Pulled material from both Design and R&T document pertaining to inks into an outline
    - Continuing to add methods from all sources – “one stop shop” document
    - more details still needed
    - Structure of the document needs to be cleaned up
    - Suggestion to put methods into a table on what information and properties of inks that are needed to be reported
    - To be submitted for Ballot when ready

Attachment: FHE-TF-Reports_April29

5.3 *FHE Reliability & Testing*

Pradeep Lall (Auburn University) presented for this activity. Of note:

- Leadership: Pradeep Lall (Auburn University), Giorgio Bazzan (CIV USAF AFMC AFRL/RXME)
- TF Roster *{refer to attachment}*
- SNARF 7242: Guide for Reliability of Flexible Hybrid Electronics
- Scope of the Document: Focus on methods for evaluation of FHE assemblies and systems, including but not limited to substrates, inks, interconnect materials, encapsulants, and electronic components in fabricated FHE test vehicles post assembly to determine the reliability of the combined design and production process.
- The scope of the topics developed include:
    - Accelerated Tests and Levels
    - Failure Modes and Mechanisms
    - Qualification of New and Replacement Materials
    - System‐Level Qualification
    - Modeling Methods for Life Prediction
    - FHE Integration with Components
    - Quality Assurance and Process Repeatability
- Current
    - Interim Draft of Reliability Test Standard is being worked on.
    - Initial round of review by SEMI.
    - Student Group Working through a number of existing standards and their Scope.
    - Identified the technical gaps and where a SEMI standard is needed IPC-2292A, IPC4921A, IPC6902
- Market Drivers
    - Mitigate risk of new product failures
    - System design for reliability
    - Methods to design out failure modes
    - Consistency of source materials and assurance of stable supply chain
    - Ensure system performance in operation
    - Methods for assessment and adoption of new manufacturing methods
    - Promote the use of FHE in complex systems
    - Six-sigma quality and high yield
    - Failure rates and design evaluation.
- Reliability Gaps
- Identify tests for reliability assurance
- Test structures, Pareto-ranking, in-situ monitoring tools
- Robust library of material parameters and characterization methods
- Correlation of lab-tests and field life
- Understand the reliability of chips, interconnections, connectors and interfaces
- Process and controls for repeatable output. Alignment of material and process needs
- Application modeling tools for FHE; validated models and data-sets.

Attachment: FHE-TF-Reports_April29

5.4 *FHE Assembly (did not meet)*

Jarrid Wittkopf (HP) stepped down as TF leader due to job title change and John Williams (Boeing) currently has no bandwidth, therefore both TF leaders have stepped back on SEMI Standards activities until further notice.

6 Old Business

6.1 *Task Force Leader(s)*

Looking for additional help/leader for FHE Assembly Task Force.

7 New Business

7.1 *Task Force Timeline/Action*

Randall Parker (DISCO) brought up this topic. Of note:

If no report has been made from a TF for three consecutive TC Chapter meetings, or no TF leadership has existed for two consecutive TC Chapter meetings or a year, whichever is longer, the TF should be discharged or sent to Dormant status (PM § 6.4.5.9.1).

7.2 *New Topics*

Paul Trio (SEMI) brought up this topic. Of note:

Any new topics come up for discussion?

- None (Randy)
- Certainly some, but not actively looking now (Dan)
- Japan/Taiwan chapters working on E-textiles
    - E-textiles are interesting; although out of scope (Steve)

7.3 *Improve Future Attendance*

Randall Parker brought up this topic. Looking for more interest. Paul Trio (SEMI) responded: Of note:

- Possibly, look into other Flexible events
- And/or related conferences outside of SEMI
- Recruit and leverage communication channels
- Sync up with Japan/Taiwan channels

8 Action Item Review

8.1 New Action Items, if any, are noted in Table 11. Previous action items, if any, are noted in Table 12 in 'red' and for recent updates in 'blue'. There is no further business.

9 Next Meeting and Adjournment

9.1 The next in-person meeting is tentatively scheduled for the week of October 6-9, in conjunction with SEMICON West 2025 in Phoenix, Arizona. Please check the SEMICON West website for updates: https://www.semiconwest.org/special-features/standards.

Adjournment: 09:46.

Respectfully submitted by:

Laura Nguyen

Sr. Coordinator, International Standards

SEMI Global Headquarters

Phone: +1.408.943.7019

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Minutes tentatively approved by:

Randall Parker (DISCO USA), Co-chair	<Date approved>
Ahmed Busnaina (Northeastern University), Co-chair	<Date approved>

Minutes approved by: **XXXX**

Table 13 Index of Available Attachments[#1]

Title	*Title*
SEMI Standards Required Elements	Staff Report Feb 2025 v3_FHE
[2023Sept] FHE NA TC Chapter Meeting Minutes draft	02-25-Flexible Hybrid Electronics
Liaison Report_FHE Taiwan_20250326_R1_LNN	FHE-TF-Reports_April29
Liaison Report_FHE Japan TC Chapter_March 2025_R1_LNN	

#1 Due to file size and delivery issues, attachments must be downloaded separately. A .zip file containing all attachments for these minutes is available at www.semi.org. For additional information or to obtain individual attachments, please contact Laura Nguyen at the contact information above.