Components for Military & Space Electronics (CMSE)
April 25-27, 2023

National Aeronautics and
Space Administration

Recent Advances In Microcircuit Standards

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Sci-fi concept with Orion spacecraft and big Moon on background. Artemis space program to research solar system. Mission to the Moon.

Elements of this image furnished by NASA.

http://nepp.nasa.gov

NASA Electronic Parts Assurance Group (NEPAG)

NEPAG

- **NEPAG is about Standards for electronic parts, finding solutions for NASA flight projects/programs, and day-to-day parts issues. We are part of NASA SMA's Mission Assurance Standards and Capabilities (MASC) Division.**
  - Maintenance
    - ❖ Provide NASA leadership
  - Creation
    - ❖ Infuse New Technology, e.g., Class Y for Space
    - ❖ Address the advances in packaging technology, e.g., a newly started task group (TG) on 2.5D/3D devices
    - ❖ Respond to user requests, e.g., creation of a new TG that developed requirements for Class P, standard plastic encapsulated microcircuits (PEMs) in Space
  - Related Activities
    - ❖ Hold telecons
      - ➢ NASA Electronic Parts Assurance Group (NEPAG)
        - ▪ Weekly Domestic and monthly International
      - ➢ Government Working Group (GWG)
        - ▪ Detailed discussion of topics, build community consensus
      - ➢ Hybrid Working Group (HWG)
    - ❖ Support Defense Logistics Agency (DLA) audits of supply chain
    - ❖ Partnerships: JEDEC, SAE, Domestic and International space organizations, DLA, GIDEP, others
    - ❖ Standard microcircuits drawing (SMD) review
    - ❖ Outreach (Publish NASA EEE Parts Bulletins, present at meetings)
    - ❖ Learn and Lunch Webinars with the supply chain
    - ❖ Parts issues resolution at JPL. Booklet in progress
    - ❖ Other as needed

Hybrid Working Group (HWG) Meeting

- **HWG**
  - Meets monthly
  - Chaired by J. Pandolf, NASA/Langley
  - Recently discussed topics
    - ❖ Upcoming DLA audits of hybrid suppliers
    - ❖ Definition of a hybrid microcircuit
    - ❖ Corporate acquisitions in the news
    - ❖ Review & Discussion on the Challenges Facing the Selection, Review, Approval of Hybrid MIL-PRF-38534 Device
    - ❖ Follow up on issues with U. S. suppliers as reported by International partners

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Government Working Group (GWG) Meeting

- **GWG**
  - Meetings held bi-weekly
  - Chaired by C. Schuler, Navy Crane
  - NASA representative: B. Damron
  - GWG forms the space community position on various technical issues
  - Recently discussed topics
    - Review of NEPAG agenda for that week
    - DLA documents in review
    - ESDS test requirement in MIL-PRF-38535
    - Specification issues with diodes
    - CSAM test method review

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February 14, 2023 Draft Document Review Table: Requirements, Guidelines, and EP Studies

Item	Released	Comments Due (Including Extensions)	Specifics
MIL-PRF-19500/578R w/Amendment 2 (Initial Draft) Semiconductor Device, Diode, Silicon, Switching, Types 1N6638, 1N6642, 1N6643, Quality Levels JAN, JANTX, JANTXV, JANS, JANHC, and JANKC FSC: 5961 Dated: 14 February 2023 File name: idprf19500ss578.pdf, File Size: 935 kb Parent Document: MIL-PRF-19500	02/14/2023	03/16/2023	Draft proposal generated to remove note 2, for the A version die, change the Al and gold thickness for the C version die, and add a new F version die, the AMSE 14.5 figure references are being removed, and update to latest MIL-STD-961, and section 508 standards. POC: Greg Cooley Gregory.Cooley@dla.mil
MIL-PRF-39016/21K (Initial Draft) Relays, Electromagnetic, Established Reliability, DPDT, Low Level to 1.0 Ampere (Sensitive, 60 Milliwatts) with Internal Diodes for Coil Transient Suppression and Polarity Reversal Protection FSC: 5945 Dated: 13 February 2023 File name: idprf39016ss21.pdf, File Size: 300 kb Parent Document: MIL-PRF-39016	02/13/2023	03/15/2023	Draft generated to implement MIL-STD-961 boilerplate updates, and incorporate 508 compliance. POC: Erika Baker erika.baker@dla.mil

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Example of Parts Needed Bulletin

Coordinator: Jay Brusse, NASA GSFC

NEPAG EEE Parts Needed Bulletin # 2023-003 **February 19, 2023**
(Note: Email Distribution List has been suppressed)
Purpose:
The NASA EEE Parts Assurance Group (NEPAG) is contacting you on behalf of a Project that is in need of the following EEE parts. NEPAG requests that you review inventories of EEE parts accessible to you and your organization to see if you have the ability to help out the Project noted below. Please direct your responses to this request DIRECTLY to the Project point of contact listed below:

Name:
NASA Center
Phone
email

Part #: K-J1A, K-J1A-254, K-J2A, K-J1A-254 or similar variations.
Generic: K-J1A
Description: K SERIES RELAY, Non-Latching, 4PDT, 12A
Mfgr: Leach
Quantity needed: Any quantity

NEPAG thanks you in advance for your assistance

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Partnerships (NEPAG is about collaboration)

JEDEC JC-13 (Manufacturers)

JC-13	Solid State Devices for Government Products
JC-13.1	Discrete Semiconductors for Government Products
JC-13.2	Microelectronics for Government Products
JC-13.4	Radiation Hardness
JC-13.5	Hybrids and Multi-chip Modules for Government Products
JC-13.7	New Electronic Device Insertion for Government Products

SAE CE-11/CE-12 (Industry Users, Primes, Subs)

SAE SSTC CE-11	Users of Passive Components
SAE SSTC CE-12	Users of Solid State Devices **CE-12 Management:** **Co-Chairs: S. Agarwal (NASA) and A. Touw (Boeing)**
SAE SSTC CE-11 & CE-12	Space Subcommittee Chair: P. Majewicz (NASA)

Joint meetings held 3 times a year

Weekly NEPAG and Biweekly GWG Telecons (Domestic)

Monthly Telecons (International and HWG)

NASA Centers:

ARC	JSC
GRC	KSC
GSFC	LaRC
JPL	MSFC

Partners from Outside NASA:

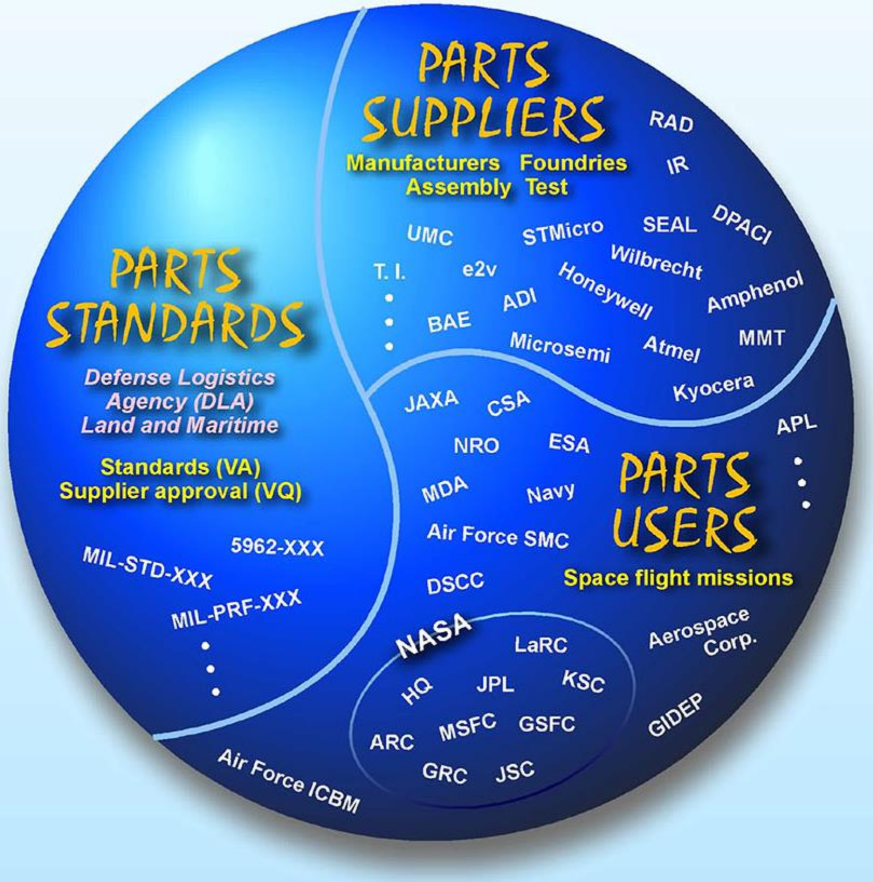
Domestic
- JHU/APL, Others
- The Aerospace Corp,
- U.S. Air Force, U.S. Navy,
- U.S. Army, MDA, DLA

International
- ESA, JAXA, CSA

NEPAG

Space Parts World

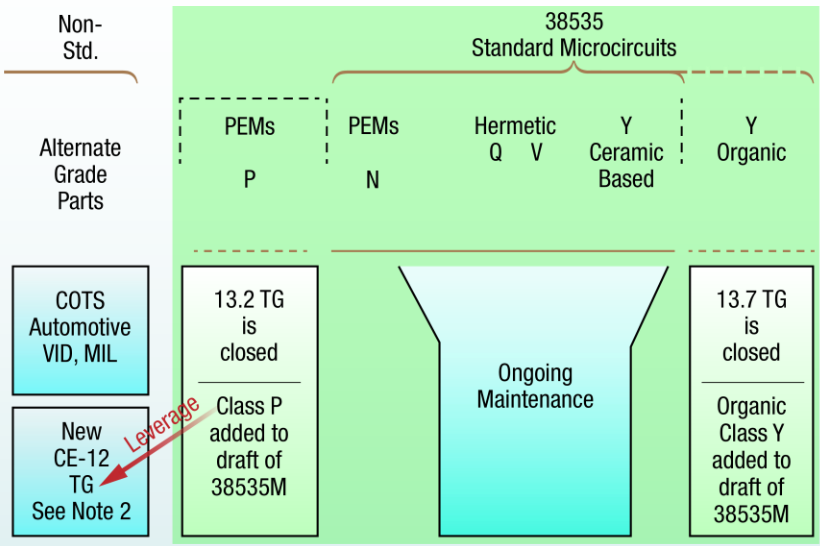
Developing/Maintaining Standards for Electronic Parts



The parts users and standards organizations work with suppliers to ensure availability of standard parts for NASA, DoD, and others. **For Space microcircuits, DLA, NASA/JPL (S. Agarwal*) and the U.S. Air Force / Aerospace Corp. (L. Harzstark) form the Qualifying Activity (QA).**

*Also SAE CE-12 Co-Chair.

Microcircuit Standards Development



- Note 1: Standard PEMs for Space (QMLP) initiative using SAE AS6294 as baseline. Supported by NASA Parts Bulletins on PEMs.
- Note 2: For alternate grade microcircuits, follow the activity in 13.2 TG to avoid any duplication of effort.
- Note 3: ATM = Advanced Technology Microcircuits. Supported by NASA parts bulletin on KGD.
- Note 4: VID = Vendor Item Drawing. Contact DLA for latest information.
- Note 5: ***The boundaries separating various classes/grades must be clearly defined—a future outreach activity.***

The much awaited revision M of microcircuits specification, MIL-PRF-38535, has been officially released. It introduces two new classes of standard parts for space missions:

(a) Organic Class Y which has been baselined for NASA's high-performance spaceflight computing (HPSC) processor to be developed by Microchip Corporation, and

(b) Class P, Radiation Hardened/Tolerant Plastic Encapsulated Microcircuits (PEMs) for Space. The flight projects can realize substantial cost/schedule savings by procuring standard Class P parts (rather than buying commercial-off-the-shelf (COTS) PEM devices and getting them upscreened).

(i) TI's first Class P product: LMX1906 a Low-Noise, High-Frequency Buffer/Multiplier/Divider (300-MHz to 12.8-GHz output frequency). SMD 5962-23202, Availability Dec 2023.

The green area shows current standards coverage. This pretty much completes the standards coverage for 38535 devices.

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NASA EEE Parts Bulletin, May 2020

National Aeronautics and Space Administration

EEE Parts Bulletin

Electrical, Electronic, and Electromechanical

A periodic newsletter of the NASA Electronic Parts Program / NASA EEE Parts Assurance Group and the Jet Propulsion Laboratory

October 2019–March 2020 • Volume 11, Issue 1,[1] May 15, 2020

Non-Hermetic and Plastic-Encapsulated Microcircuits

The mission assurance organizations at NASA have supported many large and small space missions and programs over the years. Today that spectrum has expanded, ranging from flagship missions such as Mars 2020 with its Perseverance Rover, Europa Clipper, and the proposed Europa Lander, to SmallSats/CubeSats such as the Temporal Experiment for Storms and Tropical Systems—Demonstration (TEMPEST-D) and Mars Cube One (MarCO). Plastic-encapsulated microcircuits (PEMs) have become more attractive since leading-edge alternatives are not available as space-qualified products. PEMs generally have smaller footprints and are lighter than the ceramic packages used in space-qualified products [1]. As the demand and use of non-hermetic and plastic-encapsulated microcircuits for space has increased, the scope of what future missions are capable of has also widened. This changing climate related to EEE parts selection presents new challenges for NASA, which—as always—holds the success of every mission paramount.

Growing Use of NASA SmallSats and CubeSats

Due to the need for low-cost communications satellites and new businesses evolving around Earth-observation services, there's been an increased interest in the use of CubeSats and SmallSats. Many NASA centers have been involved in developing and flying CubeSats and SmallSats, working together with multiple universities and industry partners. These undertakings require new product solutions for smaller, lighter, and lower-cost spacecraft, which cannot be produced using traditional space-qualified electronic parts.

The reliability and radiation requirements for CubeSats and SmallSats are significantly lower than for larger spacecraft because these smaller satellites operate mainly in low Earth or geosynchronous orbits (LEO or GEO, as opposed to deep space) and for relatively short periods. Radiation-hardened, high-reliability, space-grade parts are often too expensive for such missions and do not match well with their requirements.

There are a few notable exceptions to the usual use of CubeSats, particularly MarCO-A and MarCO-B, which were the first CubeSats to fly to deep space, where they successfully supported the Interior Exploration Using Seismic Investigations, Geodesy, and Heat Transport (InSight) mission by relaying data to Earth from Mars during the entry, descent and landing stage (Figure 1). MarCO successfully demonstrated a "bring-your-own" communications-relay option for use by future Mars missions in the critical few minutes between Martian atmospheric entry and touchdown. Further, by verifying that CubeSats are a viable technology for interplanetary missions, and feasible on a short development timeline, this technology demonstration could lead to many other applications to explore and study our solar system.

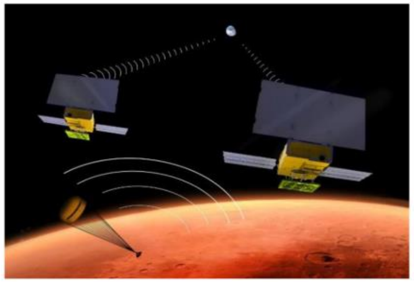

Figure 1. MarCO accompanying the InSight Mars lander and relaying data to Earth as it landed on Mars.

[1] The EEE Parts Bulletin was not published in fiscal year 2019 (FY19). The two issues of Volume 10 were published in FY18.

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NASA EEE Parts Bulletin
Special Edition: Non-Hermetic and Plastic-Encapsulated Microcircuits, Part 2
URS296932, CL#20-6169

National Aeronautics and Space Administration

EEE Parts Bulletin

Electrical, Electronic, and Electromechanical

A periodic newsletter of the NASA Electronic Parts Program / NASA EEE Parts Assurance Group and the Jet Propulsion Laboratory

Volume 12, Issue 1,[1] October 20, 2020

Non-Hermetic and Plastic-Encapsulated Microcircuits, Part 2

The mission assurance organizations at NASA have supported many large and small space missions and programs over the years. Today, that spectrum has expanded, ranging from flagship missions such as Mars 2020 with its Perseverance Rover, Europa Clipper, and the proposed Europa Lander, to SmallSats/CubeSats such as the Temporal Experiment for Storms and Tropical Systems—Demonstration (TEMPEST-D) and Mars Cube One (MarCO). Plastic-encapsulated microcircuits (PEMs) have become more attractive since leading-edge alternatives are not available as space-qualified products. PEMs generally have smaller footprints and are lighter than the ceramic packages used in space-qualified products [1]. As the demand for and use of non-hermetic and plastic-encapsulated microcircuits for space has increased, the scope of what future missions are capable of has also widened. This changing climate of EEE parts selection presents new challenges for NASA, which—as always—holds the success of every mission paramount. In this second issue devoted to non-hermetic and plastic-encapsulated microcircuits, we discuss more manufacturers' PEMs flows, and introduce the AS6294/1 aerospace standard document on "Requirements for Plastic Encapsulated Microcircuits in Space Applications."

Aerospace Standard AS6294/1

Due to the need for low-cost communications satellites and for new businesses evolving around Earth-observation services, there's been increased interest in the use of CubeSats and SmallSats for such missions. Many NASA centers have been involved in developing and flying CubeSats and SmallSats, working with multiple universities and industry partners. These undertakings require new product solutions for smaller, lighter, and lower-cost spacecraft that cannot be produced using traditional space-qualified products.

In 2017, a subcommittee of SAE International's Group 12 (G12) was created to standardize a PEMs flow and to address a possible future extension of the Qualified Manufacturer List (QML) system to include PEMs for space. Considerable effort was put into developing a PEMs flow for space applications, documented in SAE Aerospace Standard AS6294/1, issued in November 2017, titled "Requirements for Plastic Encapsulated Microcircuits in Space Applications." The "/1" version was directed at space applications, the "/2" version at terrestrial applications. SAE AS6294/1 pulled information from many Marshall Space Flight Center (MSFC), Goddard Space Flight Center (GSFC), and SAE standards applicable to NASA—namely, MSFC-STD-3012, GSFC EEE-INST-002, GSFC PEMS-INST-001, and SAE SSB-001—as well as reviews of multiple industry practices.

AS6294/1 defines the requirements for screening, qualification, and lot-acceptance testing for use of PEMs in space flight applications. The level of testing is dependent on the risk approach, the application, and the reliability and radiation requirements of the mission. However, AS6294/1 contains only requirements that meet the highest known reliability for space applications. The document also addresses many concerns associated with PEMs, such as narrower operating temperature ranges and greater susceptibility to infant mortality and moisture absorption than space-grade products have [2].

AS6294/1 starts with device characterization for parts that don't meet space requirements. The characterization step includes the initial investigations needed to understand the details of the technology used in a PEM product [2]. This is crucial when the

[1] This issue is a follow-on to Volume 11, Issue 1, released May 15, 2020: "Non-Hermetic and Plastic Encapsulated Microcircuits."

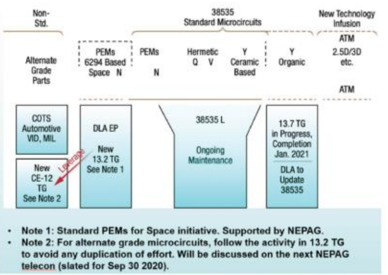

Figure 1. Options for standard, nonstandard, and new-technology microcircuits.

TG will be heavily leveraged in order to avoid any duplication of effort. See **Figure 1** for details on current and future options for nonstandard, standard, and new-technology microcircuits.

Manufacturer Solutions for Non-Hermetic and Plastic-Encapsulated Microcircuits

Historically, satellite programs have used space-grade, hermetically sealed, QML-V (space) and QML-Q (military) qualified components for enhanced reliability and radiation hardness. With the emergence of "commercial space," there has been increased interest in using PEMs in space for a variety of reasons. Countering the concerns cited above—narrow operating temperature ranges and susceptibility to infant mortality and moisture absorption [2]—are certain advantages of PEMs over most space-grade hermetically sealed microcircuits: lower cost and weight, more advanced performance, lower power consumption, and smaller overall package size.

With this new growing trend in the market, an increasing number of suppliers now offer a wide range of enhanced plastic product solutions depending on quality, reliability, radiation, and cost. Not all of these product lines follow a consolidated test flow, and all depend on the specific tailoring that each manufacturer makes to them. Hopefully, in the near future, the industry will lean

reduced screening requirements, resulting in reduced cost and lead times.

Microchip also provides two space plastic flows: HiRel plastic radiation-tolerant (HP) and 8-lead plastic small-outline (SN). The HP flow is for low-cost and high-volume requirements, typically meeting low-Earth-orbit (LEO) constellations' needs. The SN flow provides a higher screening level, including wafer lot acceptance, serialization, 100% thermal cycling, 100% burn-in, and PDA. These flows apply to both rad-hard-by-design and rad-tolerant products. Products made to these flows (SN, HP) meet qualification levels compliant with automotive requirements (AEC-Q100), with the SN flow based on AS6294/1. See **Table 2** for more details on the screening and qualification flows for Microchip HP and SN devices [4].

Micross offers an extensive array of COTS components—both hermetic and plastic—including a wide selection of power modules and small-signal discretes. They also stock a wide range of upscreened plastic products, including an assortment of integrated PEM (iPEM) memory devices that have been tested to selected high-reliability performance levels. In their Retail+ products line, Micross provides customers with industry-leading

Table 1. Teledyne e2v has various plastic non-hermetic test flows.

NASA EEE Parts Bulletin
Special Edition: Known Good Die
A JPL/MSFC Joint Effort
URS299800, CL#21-2280


National Aeronautics and Space Administration

EEE Parts Bulletin

Electrical, Electronic, and Electromechanical

A periodic newsletter of the NASA Electronic Parts Program / NASA EEE Parts Assurance Group and the Jet Propulsion Laboratory

Volume 12, Issue 2, May 2021

Known Good Die

There are many use cases for which engineers and designers elect to purchase bare die for their applications. They might integrate the die into a multichip module (MCM), or use it directly as a chip-on-board (COB), in order to meet size, cost, and mass constraints. In some special radio frequency (RF) applications a COB solution might be required to minimize the inductance and capacitance of integrated circuits leads. Furthermore, many manufacturers purchase bare die from other providers and integrate it into their packaged parts. The term "known good die" (KGD) is commonly used when referring to these die purchases; however, it is not well defined and might have different meanings depending on the manufacturer or specific use cases. In this bulletin, we describe what KGD might refer to and some of the detailed flows that KGD go through at different manufacturers.

"QML Die" in MIL-PRF-38535

Under MIL-PRF-38535, "QML die" can have several different meanings. The first is Qualified Manufacturers List (QML) die that is covered by Appendix A in the Standard Microcircuit Drawing (SMD) of the part that is offered in die form. This is commonly referred to as "SMD die" and is assigned a die code of "9" in the QML part number's case outline position. **Figure 1** shows an example of such a part (5962-96663). It is important to note that the manufacturers that offer the SMD die are also expected to offer the fully packaged part (per the SMD) on the QML listing.

Figure 1. SMD die example showing the die code.

For QML die products, the minimum screening steps are listed in the SMD (Section A.4.2). Some manufacturers might elect to do more testing than the minimum requirements, shown in **Figure 2** (from 5962-96663).

Figure 2. SMD die minimum screening required.

The 100% wafer probe includes functional and parametric testing sufficient to make the packaged die capable of meeting the electrical performance requirements listed in the electrical characteristics table of the SMD, which lists parameters throughout the part's rated temperature range. It is important to note that QML die is not required to go through temperature cycling or burn-in at the die level. However, as specified in MIL-PRF-38535, Section 4.2, all QML integrated circuits shall meet the requirements of the screens specified in Tables 1A and 1B of the specification whether or not the actual testing has been performed. The manufacturer might elect to eliminate or modify a screen based on supporting data that indicates that for the QML technology, the change is justified. For example, many manufacturers have optimized their wafer probe process and in agreement with the Defense Logistics Agency (DLA) perform it only at 25°C. If such a change is implemented, the manufacturer is still responsible for

1

...ets all of the performance ...ements of MIL-PRF-38535. ...s is performed on packaged ...quality level. Furthermore, ...r devices to be delivered as ...ples from the wafer lot shall ...accept level of 10(0).

...e is one that comes from a ...y/line/process that has been ...vered under a QML-38535 ...ML die sales are not listed in ...icate of Conformance (CoC) ...oved fab would exempt the ...erforming a site audit of the ...ype of QML die are: National ...Texas Instruments (TI), or ...elling their wafer/die from ...ies/facilities/lines/processes ...s.

...ove, the term "KGD" is not ...meanings for different ...ent products. Currently, ...fine KGD. ...PRF-38534 defines KGD as "a ...ty and reliability level as an

...F-19500

...ied Products List (QPL), die is ...s, JANHC and JANKC, which ...of the standard. Military- ...MIL-PRF-19500 JANHC die, ...classified as MIL-PRF-19500 ...e manufactured and sourced ...facility that has been used to ...e QPL. Manufacturers of QPL ...s can be either in-house or ...ust be audited and qualified ...See **Figure 3** for an example ...9500 die (JANHCAR2N2857). ...specifies the screening and ...or JANHC and JANKC die. The ...requirements are congruent ...t evaluation requirements.

6.5.2 Un-encapsulated devices. The PINs for un-encapsulated devices are constructed using the following form.

Figure 3. Example specification of a JANHC die.

JANHC and JANKC QPL die are electrically probed for key electrical parameters, and defective die are identified during this process. Wafer screening requirements are specified in Paragraphs G.5.2 through G.5.2.7. Screening consists of 100 percent electrical test, 100 percent visual inspection of die, and then additional screening of sample die assembled into packages. The minimum sample size is 10 die for each JANHC wafer inspection lot and 22 die for each JANKC wafer inspection lot. The QPL sample die will be assembled into the appropriate package by the QPL manufacturer prior to going through the screening process steps 4–7 listed in Appendix G, Table II, of MIL-PRF-19500. These include temperature cycling, mechanical shock or constant acceleration (JANKC die only), electrical test (read/record), high-temperature reverse bias (HTRB), electrical test read/record, burn-in, electrical test read/record, steady-state life (JANKC die only), electrical test read/record, wire-bond evaluation, die-shear evaluation, scanning electron microscope (JANKC die only), and radiation-hardness assurance. Appendix G, Paragraph G.5.4 specifies that die shall be stored in dry nitrogen or another inert atmosphere. All MIL-PRF-19500 QPL die are manufactured on a DLA-audited and -certified manufacturer's wafer fabrication processing facility/line. To ensure traceability, the DLA-qualified manufacturer will provide a CoC for the die manufacturer, as required per MIL-PRF-19500, Paragraph 3.7.

MIL-PRF-19500 does not define KGD, nor does it permit non-QPL die to be used in MIL-PRF-19500 qualified products.

Manufacturers' Die Offerings

Many manufacturers offer products in die form at various quality levels. For example, the following manufactures offer SMD die per MIL-PRF-38535 as described above: Analog Devices, Cobham, Honeywell, Mercury, Microchip, Micross, Renesas, STMicroelectronics (ST), and TI. Some examples of

2

...manufacturers that sell QPL ...rtified wafer foundries/process ...chip, Semicoa, Sensitron, and ...section we'll describe a couple ...vels offered by some MIL-PRF- ...demonstrate a few available

...ace-qualified products in die ...e products are offered in two ...the packaged products are ...Model (EM), and Flight Model ...ered in two different flows, ...ce Components Coordination ...neral manufacturing flow for ...own in **Figure 4**.

...roelectronics die flow.

...the Engineering Model Quality ...1), whether they are QML or ...ie form come from a qualified ...th a CoC. The EMs are not ...reening or testing. ST space FM ...duct's SMD (they are SMD die ...he FM parts follow the Die ...lity Specification (TN0873)[1]. ...sists of a visual die sort that ...010 Condition A for QML-V die, ...e. **Table 1** summarizes the EM

...ectronics EM and FM die.

...t identified interest from its ...such as burn-in or 100% high- and/or low-temperature test at electrical wafer sort (EWS), commonly referred to as KGD. ST's QML-V products are proposed in die form only when it can be agreed with DLA that an EWS at 25°C plus a wafer lot qualification test on 25 pieces at -55°C, +25°C and +125°C is sufficient to make the packaged die capable of meeting the electrical performance requirements of the SMD.

TI offers a wide variety of products in die form. TI defines KGD as "die tested to the same quality and reliability standards as their packaged equivalents" [2]. **Figure 5** shows TI's die parts categories.

Die Sales
Class Q and Class V Known Good Die - die fabricated, tested, and qualified in compliance with MIL-PRF-38535 QML Class Q or Class V and specified in a Standard Microcircuit Drawing (SMD). RHA is available.
Military and Space Grade Tested Die – Tested Die fabricated on a MIL-PRF-38535 certified manufacturing line and tested for DC and functional performance only at ambient temperature. Legacy
Known Good Die (KGD) – commercial grade die specified for full performance over a specified temperature range.
Commercial Tested Die (TD) – commercial grade die tested for DC and functional performance only at ambient temperature.

Figure 5. Texas Instruments die categories.

An example flow of a QML-V die is shown in **Figure 6**.

Example Flow (QMLV Class V die): Wafer Fabrication, Wafer Tape Mount, Multiprobe, Saw, Incoming Wafer Inspection, Sort / Pick & Place, Backgrind, Die Inspection, Post Backgrind Inspection, Pack

Figure 6. Texas Instruments example QML-V die flow.

TI's datapack available for QML die includes the data for Group C, wafer lot acceptance (Class V only), and Group E (radiation-hardness-assured only). However, the attributes (yield) and variables (read and record) are not available. TI does not offer catalog burned-in die at this time. TI does perform testing at multiprobe—for example, VBOX, GOI, and IDDQ—to ensure quality of the die. Wafer fabrication includes engineering parametric testing (test structures), wafer-level reliability testing (WLR), and outlier controls. During feasibility studies, a candidate for die sale is evaluated for packaged-device electrical-yield performance and operational life without burn-in. If either is deemed unsuitable, the device will not be released in die sale.

3

Infusion of the New Class (Y) Technology into the QML System for Space (Status given at JEDEC in January 2023)

Task Group Activities

- ☑ Review M. Sampson Idea
- ☑ Class Y Concept Development
- ☑ EP Study (DLA-VA)
- ☑ Coordination Meeting at DLA Land & Maritime (April 2012)
- ☑ DLA-VA to update 38535 with Class Y requirements and release the draft version (rev. K) for comments
- ☑ DLA-VQ to begin preparation for auditing Class Y suppliers
- ☑ 38535K Coordination Meeting
- ☑ DLA-VA to date 38535K
- DLA-VQ to begin audit of suppliers to Class Y requirements (in progress)
- Manufacturer Cert and Qual to QML-Y (DLA-VQ) (in progress)
- Users to procure QML-Y flight parts from certified/qualified suppliers (in progress)

Task Group Inputs

Government | Manufacturers | Primes | Others

G-12 Class Y Task Group Non-Hermetics in Space

- ☑ Aeroflex (October 2011)
- ☑ Xilinx (February 2012)
- ☑ Honeywell (May 2012)
- ☑ BAE (October 2012)
- ☑ e2v (January 2013)

Supplier PIDTP Presentation

- ☑ Minnowbrook Conference Oct. 2013, New York
- ☑ CMSE (Feb. 2013), LA

Conference

Task groups with Class Y interest formed and closed out.

Status as of May 2022

- Class Y First SMD available
- Qualified Mfr – Honeywell; CAES
- Certified Mfr – e2v Grenoble, Xilinx/AMD (Planned), Cypress/Infineon (Planned)
- Certified Assembly and Test – Kyocera, e2v Grenoble
- Certified Column Attach Manufacturing – Six Sigma, Micross Crewe, Micross AIT, Honeywell, and BAE
- BME IDCs: Slash Sheets available.

Note: Certification = Capability Demo, Qualification = Actually Producing Part

BGA / CGA = Ball-Grid Array / Column-Grid Array
BME = Base Metal Electrode
IDC = Inter Digitized Capacitor

PIDTP = Package Integrity Demonstration Test Plan
SMD = Standard Microcircuit Drawing

NEPAG

A Changing Landscape (Shipping/Handling/ESD Challenge)

A New Trend – Supply Chain Management
Ensuring gap-free alignment for each qualified product
(All entities in the supply chain must be certified/approved)

Manufacturer A	Die design
Manufacturer B	Fabrication
Manufacturer C	Wafer bumping
Manufacturer D	Package design and package manufacturing
Manufacturer E	Assembly
Manufacturer F	Column attach and solderability
Manufacturer G	Screening, electrical and package tests
Manufacturer H	Radiation testing

More Stops — More Places with ESD Risk

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PowerQUICC III Integrated 1.2 GHz Processor (credit: Teledyne e2v)

PC8548 – Flight Models Available

https://semiconductors.teledyneimaging.com/en/products/processors/pc854

Characteristics

- **PowerPC e500 core**
  - 800MHz to 1200MHz
  - Integrated L1/L2 Cache
  - Double-precision FPU
- **Power**
  - 5.4W typical at 1200MHz
  - 4.6W typical at 800MHz
  - 11.9W max at 125C
- **Features:**
  - Integrated DDR Memory Controller with Full ECC Support
  - Four On-chip Triple-speed Ethernet Controllers (GMACs)
  - Serial RapidIO and PCI Express High-speed interface
  - Integrated Four-channel DMA Controller
  - Dual I2C and Dual UART
  - Programmable Interrupt Controller (PIC)
- **TID:** 100krad(Si)

Benefits

- Integrated Processor
- 90nm SOI technology
- High processing power for space
- 783 HiTCE CBGA (29x29mm, Pitch 1mm)
- **QML-Y space grade, SCD 5962-20209**

Applications

- Earth observation satellites
- Weather monitoring satellites
- Telecommunication satellites
- Launch vehicles
- Manned space flight

QML-Y Certified

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DLA's VID (Vendor Item Drawing) Program

Vendor Item Drawings

Current Supplier's Program Benefits

1. Single Standardization Document
2. Controlled baseline.
3. Enhanced product change notification of processes, materials, electrical performance, finish, molding compounds and manufacturing locations.
4. Extended temperature performance.
5. Enhanced Pedigree - Reliability and electromigration checks, electrical characterization over temperature and confirmation of package performance over temperature.
6. Enhanced Obsolescence management.
7. No pure tin.
8. No copper wire bonds.

See the attached listing or check our website for an up to date list of product coverage.

DSCC ANNOUNCES THE RELEASE OF A NEW TYPE OF STANDARDIZATION DOCUMENT.

DSCC

DSCC is releasing new Vendor Item Drawings (VIDs) almost daily. These documents have been created to provide a procurement vehicle for enhanced commercial products. Specifically, commercially available microcircuit products are being documented for the first time on a standardization document. Use of these DSCC VIDs will avoid the use of manufacturer generated specification control drawings (SCDs) or manufacturer's VIDs and avoid the potential proliferation of non-standard products. The participating manufacturers have agreed to provide information and services that have not traditionally been associated with commercial products. See our website for a list of documents that are currently available.

All Vendor Item Drawings are
NOW
available on the DSCC web site

http://www.dscc.dla.mil/Programs/MilSpec/

- Analog and digital functions offered.

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The Last Page

- NASA supports a wide spectrum of space missions. The success of each of them counts.
- NASA is working with the space community to help infuse new technologies into the military standards.
- We encourage the world wide space community to get/stay involved in developing/updating standards.
- Development of workforce is an immense challenge. To that end, Tom Green's efforts are appreciated.

Thank you, CMSE, for this opportunity!

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http://nepp.nasa.gov

ACKNOWLEDGMENTS
The research described in this publication was carried out, in part, at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration. Help is gratefully acknowledged from Mohammad Mojjaradi, Jeremy Bonnell, Peter Majewicz, Susana Douglas, and Joon Park.
Government sponsorship acknowledged.