FINAL REPORT

2023-12-05 – Rev. A

QEM-CCR-2310-01399
[CPR231090108 / 534997]

AEM SINGAPORE

TI Device: TRS3221ECDBR

Customer Name:	AEM SINGAPORE	**Customer Contact:**	Meryl Terng
Customer Site:	SINGAPORE (SINGAPORE)	**End Customer**	WATERS CORPORATION
Event Type / Origin of Detection:	In-Circuit Test (ICT)	**Customer Contact(s) E-mail:**	meryl.terng@aem.com.sg
Customer Production Date:	N/A		
Customer P/N:	WA-332000775		
RMA# / SCAR#	N/A	**TI P/N or Device Type:**	TRS3221ECDBR
Customer Tracking:	534997	**TI QEM Event:**	QEM-CCR-2310-01399
Customer Notification Date:	2023-10-31	**Current Action:**	TNI

EXECUTIVE SUMMARY:

TI received **3** unit(s) of TI PN: **TRS3221ECDBR** (Customer P/N: WA-332000775) with customer provided issue description “Pin5 (C2) [Positive terminals of the voltage-doubler charge-pump capacitors] Measured 0.019738V expected 3.3V”.
TI electrical testing could not verify the customer reported issue and the customer return has been deemed **Trouble Not Identified (TNI)**.

Note: Abbreviations used in this report are listed in Appendix 2.

TEAM MEMBERS:

TI Team Members	Process Role	Email
Theeban Annamalai	FQE	theeban.annamalai@ti.com

DESCRIPTION OF NONCONFORMITY:

Identification of TI's Material						
TI Part Number:	TRS3221ECDBR					
Unit ID	**Customer Unit ID**	**LTC**	**Assembly Lot #**	**Assembly Site**	**Fab Lot #**	**Fab Site**
1	RS21EC29K	29C8XQK	2773077MY2	MLA	2141290	RFB
2	RS21EC29K	29C8XQK	2773077MY2	MLA	2141290	RFB
3	RS21EC29K	29C8XQK	2773077MY2	MLA	2141290	RFB

The following customer provided issue description was extracted from the information submitted by the customer with the returned TI devices and was entered into TI’s Quality Event Management System (QEM):

Customer Issue Description:

Customer reported issue at: **In-Circuit Test (ICT)**

Issue type: Electrical | Issue type details: Pin5 (C2) [Positive terminals of the voltage-doubler charge-pump capacitors]
Measured 0.019738V expected 3.3V
ABA swap U10 done with Pass and Fail boards
Result:
PASS Board mounted with Fail part retest becomes Fail
FAIL Board) mounted with Good part retest becomes Pass.
Customer has requested Failure Analysis report from TI

TI Issue Description:

- **ATE Verification Results**

Units	Current test program rev. Pass/Fail	Description
1	Pass	Pass
2	Pass	Pass
3	Pass	Pass

IMPLEMENT AND VERIFY CONTAINMENT ACTIONS:

TI maintains an ongoing record of returns by lot number to track the number of returned TI devices for a single manufacturing lot.

TI has reviewed the return history for this unit's manufacturing lot and has not found evidence that this unit represents a sample of a larger, systemic issue with this particular production lot. Consequently, TI did not implement any additional containment actions for this production lot during initial investigation of the customer return.

Containment Actions Description	Owner(s)	Date
1. Review the return history of wafer fab lot(s) **2141290** • **Results:** The customer return history for this fab lot(s) did not indicate an abnormal risk for the customer reported issue on the returned unit.	FQE	2023-12-05
2. Review the lot history incl. test yield performance of assembly lot(s) **2773077MY2** • **Results:** No abnormalities were noted in the assembly lot(s) history that would indicate a systemic issue exists with this lot.	FQE	2023-12-05

DEFINE AND VERIFY ROOT CAUSE:

Verification Actions:

In order to determine root cause, the customer return was tested at TI to attempt to confirm the reported issue and the following was noted:

- ATE (automated test equipment) test results using production test program suite
  - The TI device passed automated testing using the current production test program

In conclusion, TI could not verify the customer reported issue and the customer return has been deemed **Trouble Not Identified (TNI)**.
If the customer can provide more details on the state of the TI device when the issue occurred, then TI can attempt additional testing. If requested, the TI device will be sent back to the customer.

CLOSURE:

TI Report Approver	Role
Theeban Annamalai	FQE

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Appendix 2 (TI Abbreviations):

Abbreviation	Definition
8D	Eight Disciplines (8Ds) Problem Solving is a method developed at Ford Motor Company used to approach and to resolve problems. Its purpose is to identify, correct, and eliminate recurring problems, and it is focused on product and process improvement. It establishes a permanent corrective action based on statistical analysis of the problem and on the origin of the problem by determining the root causes.
A/T	Assembly Test Site
A-B-A swap	The A-B-A swap method is used to investigate whether the observed issue is caused by non-TI part related aspects on the board.
ACO	Assembly County of Origin
AEO	Analog Engineering Operations
AFM	Atomic Force Microscope
AIZU	TI internal abbreviation for TI Aizu, Japan Wafer Fab
APC	Advanced Process Control
ASO	Assembly Site of Origin
ATE	Automated Test Equipment or Final Test
ATSS	Assembly Test Spec System
Batch #	Manufacturing Batch = SAP Batch number
BiCOM	Complementary Bi Polar
BCP	Business Continuity Program and Crisis Management
BOAC	Bond Over Active Circuit (BOAC)
C/T	Curve Tracer (C/T), a typical initial verification analysis measurement equipment for voltage vs. current curves
CA	Corrective action (CA): the action taken to help eliminate the root cause
CAPA	Corrective Action & Preventive Action
Carrier	Carrier is a pocket tape, tray, tube, or other fixture used to store and transport devices and components.
CCO	Chip County of Origin
CDA	Code for TI Chengdu, China Assembly Site
CDA	Compressed Dry Air
CDM	Charged Device Model (an ESD Test)
CFAB	TI internal abbreviation for TI Chengdu, China Wafer Fab
CIP	Continuous Improvement Process
CLARK	TI internal abbreviation for TI Pampanga (Clark), Philippines A/T Site
CMP	Chemical Mechanical Polishing
CMS	Change Management System
COO	County of Origin
COP	Crystal Originated Particle(s)
COP	Customer Oriented Process
Cover Tape	Cover Tape is a clear or transparent tape
cpk	Capability Index-Centering
CPW	Chips Per Wafer
CQE	Customer Quality Engineer

Abbreviation	Definition
CRCT	Customer Return Cycle Time
CRU	Customer Returned Unit
CSO	Chip Site of Origin
CT	Cold Temperature
CT, C/T	Cycle Time
CU3	Code for TI Chengdu, China Wafer Fab
CU6	Code for TI Malacca (Melaka), Malaysia A/T Site
CUA	Code for TI Maine (Portland), USA Wafer Fab
CV	Capacitance-Voltage Measurement
CVD	Chemical Vapor Deposition
D/N	Delivery Note
DARC	Dielectric Anti-reflective Coating
DC	Datecode (D), typically shown on the TI box label in the format "YYWW" (year-year-week-week).
DDAO	TI Dallas Device Analysis Organization (Lab)
Desiccant	Desiccant is a moisture-adsorbing material placed inside sealed dry-pack bags to adsorb internal bag moisture.
DFAB	TI internal abbreviation for TI Dallas, USA Wafer Fab DFAB
Die	During this process, a wafer with up to thousands of circuits is cut into rectangular pieces, each called a Die.
DIP	Dual-In-Line Package
DIW	Deionized Water
DLN	Code for TI Dallas, USA Wafer Fab DFAB
DLS	Dynamic Laser Stimulation (DLS) can be used for failure isolation of functional failures dependent on voltage, temperature, frequency,….using TTL input of XIVA.
DM5	Code for TI Dallas, USA Wafer Fab DMOS5
DM6	Code for TI Dallas, USA Wafer Fab DMOS6
DMOS5	TI internal abbreviation for TI Dallas, USA Wafer Fab DMOS5
DMOS6	TI internal abbreviation for TI Dallas, USA Wafer Fab DMOS6
DOE	Design Of Experiment
DPPM	Defects Parts per Million
DT	Deep Trench
DUF	Diffusion under film
DUT	Device Under Test
DUV	Deep UV - (Stabilization of Resist)
ECN	Engineering Change Note
ECU	Electrical Control Unit
EDX	Energy Dispersive X-ray Spectroscopy (EDX)
EE	Equipment Engineering
EELS	Electron Energy Loss Spectroscopy
EFA	Electrical Failure Analysis
EIPD	Electrically Induced Physical Damage
EM	Electromigration (void formation)
EM	External Manufacturing
EMEA	Europe Middle East and Africa (Sales Region)
EMMI (PEM)	Photon Emission Microscopy (EMMI / PEM) is a light sensing technique basically microscope with NIR objective lenses and a NIR detector
EOL	End of Life , same as Last Time Buy (LTB)
EOS	Electrical Overstress
EPI	Epitaxy
E-pin	Ejection Pin
ESD	Electrostatic Discharge
ESD	Estimated Shipping Date
ESDAQ	Enhanced Software Defect Analysis
ETA	Eagle Test Automatic Test system
EVM	Evaluation Module that allows users to evaluate the operation and performance of TI parts
FA	Failure Analysis
FCT	Functional Circuit Test
FDAO	TI Freising Device Analysis Organization (Lab)
FFAB	TI internal abbreviation for TI Freising, Germany Wafer Fab
FIB	Focused Ion Beam
FMEA	Failure Mode and Effects Analysis (FMEA)
FMX	TI internal abbreviation for TI Aguascalientes, Mexico A/T Site (FMX)
FQAE	Field Quality Application Engineer
FT	Final Test, usually the latest revision of the test program used in the A/T site.
FTIR	Fourier Transform Infrared Microscopy
FTY	Final Test Yield (after Packaging)
GEC	Good Electrical Chip
GF6	Code for TI Greenock, Scotland Wafer Fab (6" = 150mm)
GF8	Code for TI Greenock, Scotland Wafer Fab (8" = 200mm)
GFAB	TI internal abbreviation for TI Greenock, Scotland Wafer Fab
GOI	Gate Oxide Integrity
GRR	Gauge Reproducibility and Repeatability
GSP	Good Sample Probe
HBM	Human Body Model ESD Test
HCI	Hot Carrier Injection
HDP	High Density Plasma
HIC	Humidity Indicator Card
HT	High Temperature
HTO	High Temperature Oxide (oxidation)
HTOL	High Temperature Operating Life (an Reliability test)
HTSL	High Temp Storage Life (a Reliability test)
IC	Integrated Circuit
ICP	Inductively Coupled Plasma (Dry Etch)
ICPMS	Inductively Coupled Plasma Mass Spectroscopy
ICT	In-Circuit Test
ILD	Inter Level Dielectric

Abbreviation	Definition
ILD-n	Inter Level Dielectric between Metal Levels n and n+1
ILO	Inter Level Oxide
IMD	Inter Metal Dielectric
IMDS	International Material Data System
IMPL	Implant
INQ	Inquiry
IPQC	In-Line Process control
IQC	Inline Quality Control
ITY	Integrated Test Yield
KGU	Known Good Unit
LBE	Local Business Entity
Lead-frame	Lead-frame insists as the interface area to the external terminals of the part.
LL	Lesson(s) Learned
LPCVD	Low Pressure Chemical-Vapor Deposition
LRR	Lot Reject Rate
LTB	Last Time Buy, same as End of Life (EOL)
LTC	Lot Trace Code; each TI part is marked with a unique LTC
LTO	Low Temperature Oxide (Oxidation)
MBB	Moisture Barrier Bag (MBB) or Dry Pack
MCLT	Minority Carrier Lifetime (TAU)
MCS	Metallurgic Cross-Section sample preparation is used to reveal the true component structure at a certain device location (e.g. solder joints, bond wire connection or die attach)
MDAO	TI Manchester Device Analysis Organization (Lab)
MEI	Manufacturing Equipment Installation
MES	Manufacturing Execution System
MEX	Code for TI Aguascalientes, Mexico A/T Site (FMX)
MFAB	TI internal abbreviation for TI Main (Portland), USA Wafer Fab
MFC	Mass Flow Controller
MFF	Multi Factory Flow
MfG	Manufacturing
MH5	Code for TI Miho, Japan Wafer Fab (5")
MH6	Code for TI Miho, Japan Wafer Fab (6" = 150mm)
MH8	Code for TI Miho, Japan Wafer Fab (8" = 200mm)
MIF	TI internal abbreviation for TI Miho, Japan Assembly Site
MIHO	TI internal abbreviation for TI Miho, Japan Wafer Fab
MIM	Metal-Insulator-Metal
MLA	Code for TI Kuala Lumpur, Malaysia A/T Site
MLO	Multi-Level Oxide
MM	Manufacturing Maintenance
MOCVD	Metal-organic Chemical Vapor Deposition
MOS	Metal Oxide Semiconductor Junction (Technology)
MOSFET	MOS Field Effect Transistor
MPY	Multiprobe Yield
MRB	Material Review Board
MSL	Moisture Sensitivity Level
NAC	TI will conduct a background check on the device to determine whether case monitoring is sufficient. A non-actionable case (NAC) is a direct result of this upfront background verification or physical analysis.
NMOS	N Channel Metal Oxide Semiconductor
NTF	No Trouble Found; TI could not verify the customer reported issue
NVA	Non-Value Added
O/S	Open / Shorts failures
OCAP	Out of Control Action Plan
OEE / OEU	Overall Equipment Efficiency / Overall Equipment Utilization
OFI	Opportunities For Improvement
OOC	Out of Control
OOS	Out of Spec
OPN	Operation
PA	Preventive action
Pb-free	a product that is rated RoHS & high temperature solderable (260°C) compatible.
PCD	Process Control Document
PCN	Process/Product Change Notification
PDC	Product Distribution Center (warehouse)
PDN	Product Discontinue Notification (EOL)
PE	Process Engineer(ing)
PECVD	Plasma Enhanced Chemical Vapor Deposition
PEM	Production Equipment Maintenance
PEM (EMMI)	Photon Emission Microscopy (EMMI / PEM) is a light sensing technique basically microscope with NIR objective lenses and a NIR detector
PFA	Physical Failure Analysis
PFMEA	Process Failure Mode and Effects Analysis
PHI	Code for TI Baguio, Philippines A/T Site
PI	Polyimide
Pitch	The distance from pin to pin or inter-lead spacing.
Pizza Box	Intermediate container for the fully loaded reel, carrier tape, and cover tape
PM	Preventive Maintenance
PMC	Process Monitoring Chip
PMD	Poly-Metal Dielectric(s)
PMOS	P Channel Metal Oxide Semiconductor
PO	Protective/Passivation Overcoating
PO	Purchase Order
POR	Process Of Record
PPAP	Production Part Approval Process (PPAP)
PPB	Parts Per Billion
PPM	Parts Per Million

Abbreviation	Definition
PRM	Photo Resist Mask
PSD	P Implant Source/Drain
PSG	Phosphorous Silicate Glass
PSOG	Phosphorous Spin On Glass
PSW	Part Submission Warrant (PSW)
PTN	Product Termination Notification (PTN)
PVD	Physical Vapor Deposition
QA	Quality Assurance
QAB	Code for TI Pampanga (Clark), Philippines A/T Site
QBD	Charge to Breakdown
QBS	Qualification By Similarity
QC	Quality Control
QEM	Quality Event Manager system for 8D reports
QLT	Quality Leadership Team
QRA	Quality & Reliability Assurance
QSS	Quality System Standard
QST	Quality Steering Team
QTY	Quantity
RC	Root Cause
REB	Resist Etch Back
RFAB	TI internal abbreviation for TI Richardson, USA Wafer Fab
RFB	Code for TI Richardson, USA Wafer Fab
RoHS	Restriction of Hazardous Substances Directive 2002/95/EC
RPN	Risk Potential Number
RPPM	Returned Parts per Million
RT	Room Temperature
RTA	Rapid Thermal Anneal
RTM	Release to market
RTO	Rapid Thermal Oxidation
RTP	Rapid Thermal Processing
RTV	Ramp to Volume
SACVD	Sub-Atmospheric Chemical - Vapor Deposition
SAM	Scanning Acoustic Microscopy; using ultrasonic waves to check for delamination.
SBE	Strategic Business Entity
SCI	Sub Collector Implant
SCM	Scanning Capacitance Microscopy
SCR	Standard Change Request
Scribe Line	Thin non-functional spacing is between neighboring Dies on a wafer where a saw can safely cut the wafer without damaging the circuits.
SD	Source-Drain (NSD,PSD)
SEM	Scanning Electron Microscope; imaging defects / damages beyond the resolution of an optical microscope
SFAB	TI internal abbreviation for TI Sherman, USA Wafer Fab
SFC	Statistical Factory Control
ShDAO	TI Shanghai Device Analysis Organization (Lab)
SHE	Code for TI Sherman, USA Wafer Fab
Shelf Life	Length of time that a TI part may be stored in controlled environment before mounted onto applications.
SIMS	Secondary Ion Mass Spectroscopy
SMC	Statistic Machine Control or Scribe line Monitoring Chip
SMD	Surface Mount Device
SMIF	Standard Mechanical Interface
sMPY	Standardized Multiprobe Yield
SMS	Semiconductor Manufacturing System
SO	Sales Order
SOF	State of Finish
SOG	Spin on Glass
SPC	Statistical Process Control
SRP	Spreading Resistance Probe
SS	Sample Size
STC	Unique tracking number on the TI label (1T) for each shipping container.
STI	Shallow Trench isolation
STM	Scanning Tunneling Microscope (Microscopy)
SVDAO	TI Santa Clara Device Analysis Organization (Lab)
SWR	Special Work Request
T&R	The tape-and-reel (T&R) configuration is used for transport and storage
TAI	Code for TI Taiwan A/T Site
tbd	To be done / defined
TCI	Test Coverage Issue/Improvement
TDAO	TI Tucson Device Analysis Organization (Lab)
TDBD	Time to Dielectric Breakdown
TEM	Transmission Electron Microscope
TFR	Thin Film Resistor
TICL	TI internal abbreviation for TI Pampanga (Clark), Philippines A/T Site
TID	TI Freising, Germany Wafer Fab
TID	Code for Texas Instruments Deutschland
TIEM	TI internal abbreviation for TI Malacca (Melaka), Malaysia A/T Site
TIM	TI internal abbreviation for TI Kuala Lumpur, Malaysia A/T Site
TIMS	Tool Interdiction and Monitoring System
TIPI	TI internal abbreviation for TI Baguio, Philippines A/T Site
TITL	TI internal abbreviation for TI Taiwan A/T Site
TIW	Code for Texas Instruments Warrenville
TMG	Technology and Manufacturing Group
TMX	TI internal abbreviation for TI Aguascalientes, Mexico A/T Site (FMX)
TNI	Trouble Not Identified; TI's investigation does not confirm the customer problem.
UPW	Ultra-Pure water

Abbreviation	Definition
V/I	Voltage (V) vs. Current (I) verification
Via-n	Connection between Metal Levels n and n+1
VPD	Vapor Phase Decomposition
VPO	Versaport Pod Opener
VTN	Voltage Threshold N
VTP	Voltage Threshold P
W/F	Wafer Fab
WEE	Wafer Edge Exposure
WIC	Workplace Inventory Control
WIP	Work In Process
WLP	Wafer Level Package
WLR	Wafer Level Reliability
XIVA (LSIM)	Laser Signal Injection Microscopy (LSIM) is a current sensing technique Externally Induced Voltage Alterations
X-RAY	Electromagnetic radiation that differentially penetrates structures and creates images of these structures on photographic film or a fluorescent screen. These images are called diagnostic x rays.
YE	Yield Enhancement