

Epson USB TSE Technical Specification



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1. Product Summary

- Capacities: 8 GBytes
- Form Factor: USB3.1 solid state flash drive with USB Type-A connector (24.0 mm x 12.1 mm x 4.5 mm)
- Compatibility: USB 2.0 high-speed specification compatible (backward compatible with USB 1.1)
- Operating Temperature Range ¹:
 - o Extended: -25 °C to 70 °C
- Storage Temperature Range: -40 °C to 85 °C
- Operating Voltage: 5.0 V ± 10%
- Data Retention: 10 Years (please refer to section 4.6)
- Multi-Level Cell (MLC) NAND Flash
- Hardware BCH Code ECC (up to 40bit correction per 1 KByte page)

¹ Adequate airflow is required to ensure the drive temperature

2. Product Features

2.1 Flash Features

- Page based Flash management with increased endurance & random performance
- Optimized FW algorithms especially for high read access and long data retention applications
- Proven power fail management for highest reliability
- Near Miss ECC technology
 - Minimize the risk of uncorrectable bit failure over the product life time. Each read command analyzes the ECC margin level and refreshes data if necessary.
- Read Disturb Management
 - The read commands are monitored and the content is refreshed when critical levels have occurred.
- Wear Leveling technology
 - Equal wear leveling of static and dynamic data. The wear leveling assures that dynamic data as well as static data is balanced evenly across the memory. This guarantees the maximum write endurance of the device.
- Data Care Management
 - The interruptible background process controls the user data for read disturb effects or high temperature related retention degradation and refreshes data if necessary.
- LED for operation indication
- 30 µinch gold-plated USB 3.0 Type-A connector contacts

2.2 Fiscal Solution Features

- BSI-TR-03153 compliance coming with EDS-SW ("Einheitliche Digitale Schnittstelle")
- Inalterability of data inside TSE Tar Storage
- Intuitive file based backup and data export
- Data retention 10 years (please refer to section 4.6)
- In-field firmware update in compliance with TR-03153 requirements

2.3 Supported TSE Profiles

The Epson TSE supports the following profiles according BSI TR-03153:

Supported Profile ID	Comment
STORAGE_BASIC	Has local storage (6.5 GB)
SM_BASIC	Has a local Secure Element (384 bit ECDSA, signature time <250ms)
SM_NOAGG	Supports signed transaction updates (saves 1 signature per receipt)
SM_MULTI	Supports managing multiple transactions in parallel (up to 512)
CUSTOM_INTEGRATION_INTERFACE	Manufacturer specific interface (Android, Linux, Windows, Java, embedded)
SDI_DELETE	Supports method deleteStoredData
NO_TIME_SYNC	Time is set by host
MULTI_CLIENT	Supports multiple clients (up to 100)

3. Ordering Information

Table 1: Available SKUs

Capacity	Validity	Epson SKU
8 GBytes	5 Years	7112348

The production configuration is specified as follows:

Table 2: TSE configuration

Item	Value	Remark
CSP (Smart Card)	Yes	BSI-DSZ-CC-1118, TCOS CSP 2.0 Release1/P60D145/P6022y
Overall size of all TSE_TAR files	6.5 GB	Value in GB
Key length / algorithm for digital signature	brainpoolP384r1, ecdsa-plain-384	384 bit ECC Key of the curve brainpoolP384r1 with SHA384 as hash algorithm
TSE Description	BSI-K-TR-0373 BSI-K-TR-0414	NULL terminated ASCII string containing a short description of the TSE
Storage Type	USB	Which form factor (USB / microSD / SD)
Memory Size	8GB	Memory size
Fiscal Data protection	Yes	All Fiscal Data are access protected according TR-03153
Subdirectory Support	Yes	Defines if the TSE Files shall be made available in sub directories (e.g. on Android hosts)
Certificate Validity (certificate for signing transactions)	5 years	At the time of production, the expiration date is set to 5 years and 6 months. The additional 6 months are intended as a time buffer for logistics & stocking.

4. Product Description

The Epson USB TSE provides a robust, high performance, and reliable storage product with industry compatible interface and small form factor. The USB TSE MLC technology both enables high NAND flash operation and excellent endurance. The use of page based Flash management and a global wear levelling extends the endurance to unprecedented values for USB products.

The USB TSE product allows easy operation with USB3 or USB2 Type-A sockets.

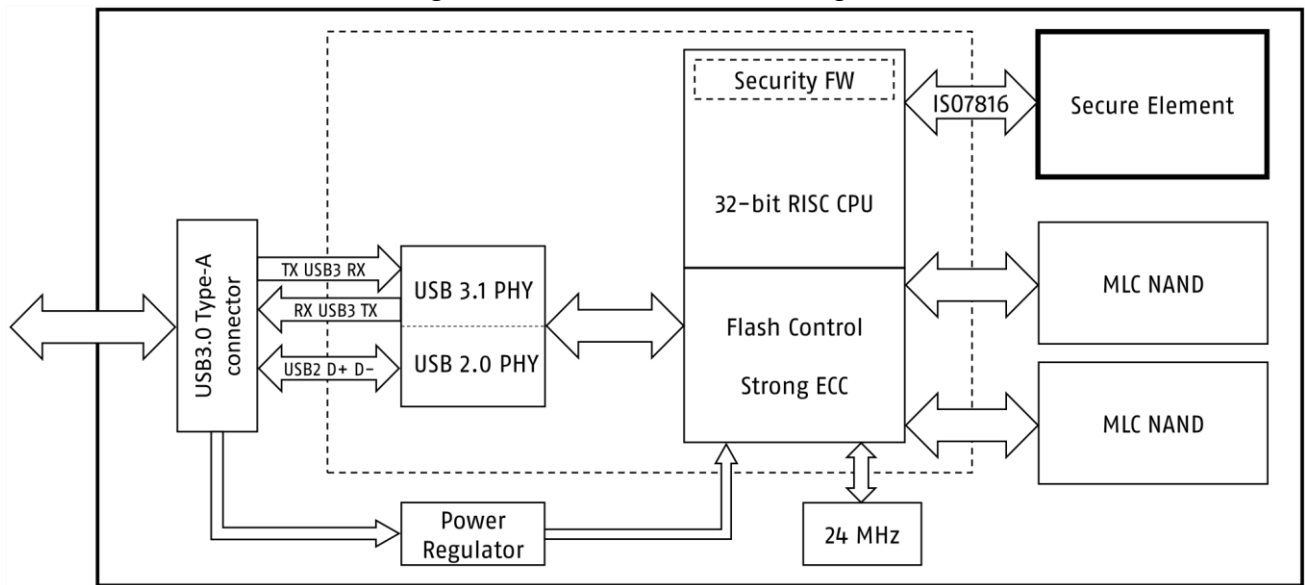
For outdoor use or in poorly ventilated systems the USB TSE is available in extended temperature grade from -25°C to +70°C. Each individual extended temperature grade drive is tested at these corners to verify the temperature resistance.

The USB TSE firmware includes data care management features which refresh storage areas that are not or only infrequently read. At high temperature storage these areas are prone to retention loss. The firmware monitors the state of the NAND blocks and refreshes those that show a high level of degradation, thus preventing uncorrectable errors.

The USB TSE operates at 5V nominal with $\pm 10\%$ tolerance.

It supports USB 2.0 high-speed and is fully backwards compatible to USB 2.0/1.1 High/Full Speed.

Figure 1: USB TSE Functional Block Diagram



4.1 Performance Specifications

The Read/Write performance cannot be fully tested due to policy restrictions that protect some areas of the freely addressable memory space.

4.2 Current Consumption

The drive-level current consumption as a function of operating mode is shown below in Table 3. During start up the idle current consumption may increase up to 55mA.

Table 3: Typical Current Consumption for max transfer speed at 5V²

Drive Capacity	Sequential Read	Sequential Write	Random Read 4k	Random Write 4k	Idle	Unit
8 GBytes	60	60	50	54	43	mA

² All values are the typical recorded at 25 °C, with 5V supply voltage at fastest CrystalDiskMark 6.0.2 x64 (CDM) in high-speed mode.

4.3 Environmental Specifications

4.3.1 Recommended Operating Conditions

The recommended operating conditions for the USB TSE flash drives are provided in Table 4 below.

Table 4: Recommended Operating Conditions

Parameter	Value
Extended Operating Temperature	-25 °C to 70 °C
Power Supply V _{CC} Voltage	5V ± 10%

4.3.2 Recommended Storage Conditions

The recommended storage conditions are listed below in Table 5.

Table 5: Recommended Storage Conditions

Parameter	Value
Storage Temperature	-40 °C to 85 °C ³

4.3.3 Humidity

The maximum humidity conditions are listed below in Table 6.

Table 6: Humidity

Parameter	Value
Humidity (Non-Condensing)	85% RH 85 °C, 1000 hrs (JESD22-A101)

³ The retention at high temperature is reduced. The acceleration factor at 85°C compared with 40°C is 170, i.e. the initial endurance 10 years@40°C is reduced to 22 days@85°C.

4.4 Regulatory Compliance

The Epson USB TSE complies with the standards listed in the following table.

Table 7: Regulatory Compliance

Compliance	Country	Type	Standard(s)/Directive
CE	European Union	Compliance	Directive 2014/30/EU: <ul style="list-style-type: none"> • EN 55032:2015, Class B • IEC 61000-6-2:2016 Directive 2011/65/EU : <ul style="list-style-type: none"> • EN 50581 (2012)
FCC	United States	Compliance	47 CFR Part 15, class B
RoHS	European Union	Compliance	2011/65/EU, 2015/863
WEEE	European Union	Compliance	2012/19/EU
REACH	European Union	Compliance	1907/2006

4.5 Mechanical Specifications

The Epson USB TSE uses a USB Type-A connector fully integrated into the metal housing. Physical dimensions and tolerances are detailed in Table 8 below. Figure 3 at page 14 illustrates the PU-50n dimensions.

Table 8: Measured Physical Dimensions

Physical Dimensions		Unit
Length	24.00±0.2	mm
Width	12.10±0.10	
Thickness (Max)	4.50±0.10	
Weight (Max Capacity)	5	g

4.6 Reliability and Data Retention

Table 9: Reliability

Parameter	Value ⁴
MTBF (at 25°C)	> 6,000,000 hours
Supported number of cryptographic signatures (reliable key usages)	20 million
Data Retention at beginning (<300 PE cycles) @ 40°C	10 years
Data Retention at life end (2k-3k PE cycles) @ 40°C	1 year

Data Retention correlates negatively with the amount of data written to the device over its lifetime. The specified endurance of this device is max. 3'000 program/erase (PE) cycles on flash cell level (MLC). After consuming the max. available PE cycles, the data retention @40°C is 1 year (i.e. data is readable after 1 year of unpowered storage at max. 40°C).

In order to attain a data retention of 10 years @40°C (i.e. data is readable after 10 years of unpowered storage at max. 40°C), the amount of data written to the card must be max. 300 PE cycles (on flash cell level).

A product feature named global wear levelling makes sure that write/erase operations to both (1) the memory area reserved for fiscal transactions and (2) the freely available memory area will be distributed evenly over the full memory capacity.

4.7 Drive Geometry Specification

Table 10: Drive Geometry

Raw Capacity	Total LBA	User Addressable Bytes
	Decimal	(Unformatted)
8 GBytes ⁵	15,663,104	8,019,509,248

⁴ After every power on the card reads the whole flash and performs a data refresh if necessary. So, the data retention can be much longer in most use cases.

⁵ 6.5 GB of the memory capacity is reserved for fiscal data, leaving 1 GB free.

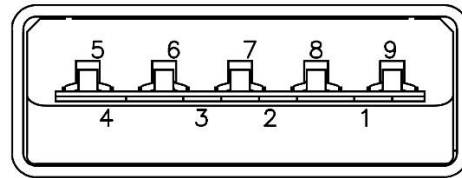
5. Electrical Interface

- USB3 Type-A connector, 9pin
- USB2.0 high-speed interface and 1.1 full-speed compatible

Table 11: Electrical pinout from device and host view.

Pin	Signal <u>device</u> view	Signal <u>host</u> view	Description <u>host</u> view
1	V_Bus	V_Bus	Operating voltage
2	D-	D-	Data signal pair
3	D+	D+	Data signal pair
4	GND	GND	Power Ground
5	SSTX-	SSRX-	Host receive -
6	SSTX+	SSRX+	Host receive +
7	GND	GND	Signal Ground
8	SSRX-	SSTX-	Host transmit -
9	SSRX+	SSTX+	Host transmit +
Shield			Connector shield

Figure 2: USB3 Type-A connector pinout



6. Electrical Specification

Table 12: Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Power Supply Voltage	V_Bus	-0.5	6.0	V
Voltage at D+ and D-	V_Data	-0.5	5.0	
Voltage at USB3 pins	V_Data	-0.5	1.8	

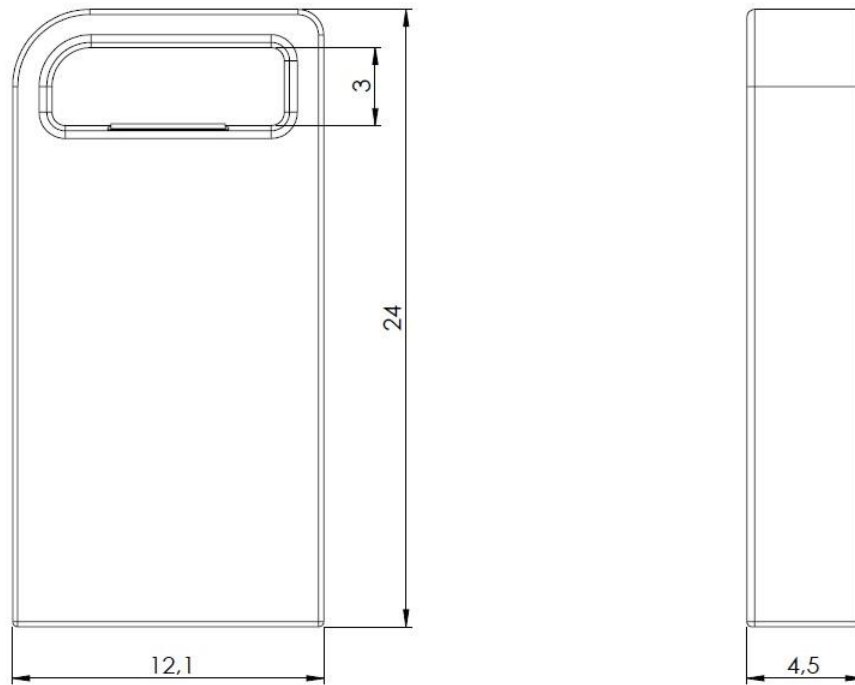
Table 13: DC characteristics for High-Speed operation (T=25°C, V_Bus=5V)

Parameter	Symbol	Density	Min	Typ	Max	Unit
Supply Voltage	V_Bus	all	4.5	5.0	5.50	V
Write current	I_WR	8GB		60	81	mA
Read current	I_RD	8GB		60	66	
Idle current	I_IDL	all		43 ⁶	55	
Suspend current	I_CCS	all		32	35	
High Speed Idle Level	V_HSOI	all	-10		10	mV
High Speed Data Signaling LOW	V_HSOL	all	-10		10	
High Speed Data Signaling HIGH	V_HSOH	all	360		440	
Chirp J Level (differential)	V_CHIRPJ	all	360		440	
Chirp K Level (differential)	V_CHIRPK	all	-440		-360	

⁶ Typically 5 minutes after power on the device performs a background data care management, that needs up to 90mA

7. Package Mechanical

Figure 3: Mechanical Dimensions in mm for Epson USB TSE



All dimensions are in millimetres, tolerances as listed in Table 8.

8. Marking Specification



Epson logo

Datamatrix-Code (Unique-ID, Production Date CWYY, Certificate Validity)

TSE TR-03153

Density

Epson SKU: 7112348

Unique-ID (8 digit Lot code & 4 digit counter)

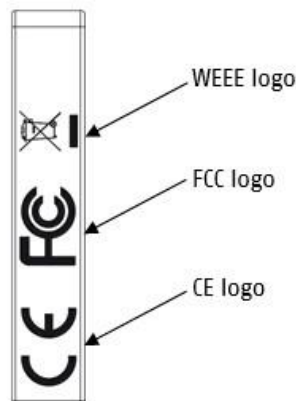
Production Date (CWYY) – Certificate validity (years)

Front view



Blank

Rear view



Side view

9. Export Control

The Epson USB TSE contains a smart card that provides exclusively digital signature functionality to recorded user data. Therefore, the Export Control Customs EU Tariff Number is 85235110.

10. Software Licensing and Disclaimers

Epson is using the following Open Source Software internally in the TSE either unchanged or in modified form.

libecc - Library for elliptic curves cryptography; provided under BSD License.

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Revision History

Table 14: Document Revision History

Date	Revision	Description	Revision Details
January 19, 2021	1.10	Added new BSI certification ID BSI-K-TR-0414	
December 06, 2019	1.00	Initial release	