S U M M A R Y D A T A S H E E T

- **NFC Forum Mandated Type 1 Tag Format**

Topaz 13.56MHz Near Field Communication (NFC) / Radio Frequency Identification (RFID) Read/Write IC

ISO/IEC 18092, 21481 & 14443A Compatible

Part Number: TPZ-201-series

www.innovision-group.com/topaz

INNOVISION RESEARCH & TECHNOLOGY PLC

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Table of Contents

Datasheet Revision History

Revision	Date	Page(s)	Description
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1. Description

The Topaz IC, (part number TPZ-201-series), has been developed by Innovision Research & Technology plc to address Near Field Communication (NFC) and Radio Frequency Identification (RFID) tagging applications working to the ISO/IEC 18092, ISO/IEC 21481 and ISO/IEC 14443A standards.

The Topaz IC based tag has been mandated by the NFC Forum as the Type 1 Tag Format to work with NFC devices.

The Topaz IC is a two terminal device designed to be connected to a loop antenna to produce a passive NFC/RFID tag operating in the standard unlicensed 13.56MHz frequency band.

The read/write data in the Topaz IC memory is EEPROM-based, allowing individual blocks to be locked into read only operation by contactless command. Once locked, the process is irreversible.

The Topaz IC is based on a physical EEPROM array size of 120 bytes.

Passive operation means that no battery is required because the Topaz IC gathers its operational energy from the interrogation field generated by the NFC Reader/Writer unit.

2. Features

- Topaz IC can be used in NFC Forum Tags/Smartposter/ One-touch Setup applications as well as general RFID
- Targeted for operation with NFC devices which work to ISO/IEC 18092 (NFCIP-1) and/or ISO/IEC 21481 (NFCIP-2)
- Designed to be compatible with the ISO/IEC 14443:2001 parts 2 and 3
- ISO/IEC 14443 type A modulation scheme
- Passive RFID tag operating in the unlicensed 13.56MHz band
- Read and Write (R/W) operation
- One Time Programmable (OTP) & Write Once Read Many (WORM) operation
- Typical operating range up to 10cm depending on tag/reader antenna coil sizes and orientation relative to the reader unit
- UID provision in Topaz IC to enable collision detection by means of the Reader/Writer issuing a RID (Read UID) command
- Fast data communication rate of 106 kbit/s
- Protection for data during the write operation by the Topaz IC only responding to commands pre-pended with a matching UID. This also provides protection in the situation where there are multiple tags in the reader field
- Fast byte write speed
- Data communications are protected by 16-bit CRC integrity checking
- EEPROM based user read/write memory area organised as 12 blocks of 8-bytes
- 7-bytes of Unique Identification (UID) number for use in data authentication/anti-cloning
- 96-bytes of user read/write memory
- 6-bytes of OTP memory
- All memory areas are individually one time lockable by RF command to prevent further modification of data and to produce read only functionality

3. Benefits

- Small die size
- Mandated as Type 1 Tag Format by the NFC Forum for operation with NFC devices in Reader/Writer mode
- Initial “Request and Answer” communication cycle between the NFC reader/writer device and the Topaz IC based NFC Tag follows the ISO/IEC 18092 and ISO/IEC 14443-3 standards
- Will operate with forthcoming ISO/IEC 18092 & ISO/IEC 21481 compliant NFC devices directly and with most existing ISO/IEC 14443 reader/writers after software modification only
- Low-power requirement
- High-integrity – 16-bit CRC protection on communications protocol
- Blocks of memory can be utilised as shadow areas for anti-tear protection measures
- Memory size and capacity is scalable for custom designs
- Two bond pad die attachment
- Wire-bond, flip-chip and module die attachment methods possible
- Suitable for operation with wide variety of antenna coil size, form factor and construction
- Fast read all command (RALL)

4. Specification

Physical/Environmental

- Die size approx 0.59 x 0.59mm (including guard ring)
- Standard 150µm thickness
- L1, L2 pad passivation opening ≥ 80µm
- 2 terminal IC for conventional wire bond or flip chip attachment
- Operating temperature range: –25°C to +50°C
- Non-operational data retention (i.e. storage temperature) range: –40°C to +70°C

Memory Map

- 16-bits (2-bytes) of metal mask product identification header ROM
- 56-bits (7-bytes) of Unique Identification (UID) number
- 768-bits (96-bytes) of user read/write memory
- User Read/Write memory arranged as 12 blocks of 8-bytes
- Each 8-byte user read/write block is individually lockable by RFID command
- For systems working on 16-byte blocks, the pairs of 8-byte blocks can be written to and locked together by the reader
- 48-bits (6-bytes) of One Time Programmable (OTP) bit area
- OTP bits can be set both individually or as multiple bits together in one command

Security

- 7-byte Unique Identification (UID) number is programmed and locked during manufacture
- Further blocks can be programmed with application specific data and then locked to provide tamper-proof contents
- OTP bits can be used for non-reversible one direction counters
- CRC protection on command and data communications to retain integrity
- All blocks, and hence all logical pages, have a one-time lock capability
- The Topaz IC can use a “Digital Certificate” or “Seal” based on the unalterable and unique identification number to authenticate and provide an appropriate level of security

General

- On-chip tuning capacitance designed for nominal 13.56MHz operation
- Read range will depend on the antenna used and reader specifications
- Fast write speed <6.5mS per byte
- “Read All” command for fast read access of complete memory contents
- Data retention >5 years
- Write operations >10,000 cycles
- Available in two standard forms:

  Tested wafer

  Tested, bumped, ground and sawn wafer (film on frame)
- Contact Innovision for ordering information and full part number

5. C-tune

C-tune is the on-chip capacitance across the device pads L1 & L2 (expected use: to tune a coil connected across L1 & L2 to a frequency near to 13.56MHz).

C-tune has been metal-mask selected as follows:

- C-tune standard = 21.1pF nominal

6. Topaz IC Identification

The Topaz IC carries a specific “Header ROM” value, fixed in memory area HR0, to identify that the tag is capable of carrying an NDEF Message as defined by the NFC-Forum.

Qualification of the HR0 value must be used by a NFC reader/writer in order to identify and segregate between tags based on the Topaz IC and on other Innovision ICs.

The header ROM, HR0 value is assigned as follows:

- Topaz IC (TPZ-201-series), HR0 = 11_h

7. Physical Memory Map

The 120-byte EEPROM array is arranged as 15 blocks of 8-bytes each. Each block is separately lockable.

There is an additional 2-byte Header ROM, where HR0 = 11_h identifies the tag as Topaz IC for NFC NDEF data applications. HR1 is reserved for internal use and shall be ignored.

HR0	HR1
11_h	xx_h

EEPROM Memory Map										
Type	Block No.	Byte-0 **(LSB)**	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7 **(MSB)**	Lockable
UID	0	UID-0	UID-1	UID-2	UID-3	UID-4	UID-5	UID-6		Locked
Data	1	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Yes
Data	2	Data8	Data9	Data10	Data11	Data12	Data13	Data14	Data15	Yes
Data	3	Data16	Data17	Data18	Data19	Data20	Data21	Data22	Data23	Yes
Data	4	Data24	Data25	Data26	Data27	Data28	Data29	Data30	Data31	Yes
Data	5	Data32	Data33	Data34	Data35	Data36	Data37	Data38	Data39	Yes
Data	6	Data40	Data41	Data42	Data43	Data44	Data45	Data46	Data47	Yes
Data	7	Data48	Data49	Data50	Data51	Data52	Data53	Data54	Data55	Yes
Data	8	Data56	Data57	Data58	Data59	Data60	Data61	Data62	Data63	Yes
Data	9	Data64	Data65	Data66	Data67	Data68	Data69	Data70	Data71	Yes
Data	A	Data72	Data73	Data74	Data75	Data76	Data77	Data78	Data79	Yes
Data	B	Data80	Data81	Data82	Data83	Data84	Data85	Data86	Data87	Yes
Data	C	Data88	Data89	Data90	Data91	Data92	Data93	Data94	Data95	Yes
Reserved	D									
Lock/Reserved	E	LOCK-0	LOCK-1	OTP-0	OTP-1	OTP-2	OTP-3	OTP-4	OTP-5	

Reserved for internal use
User Block Lock & Status
OTP bits

Block usage	
Block 0	7 bytes of Unique ID.
Blocks 1 – C	All 96 data bytes are available to the user as Read/Write memory.
Block D	Reserved for internal use.
Block E	Used for OTP (One Time Programmable) bits. The least significant 2-bytes are used to store the individual block-lock status. The most significant 6-bytes are used for the 48 OTP bits.