TOSHIBA

DCC Network Evolution Programme, Lot 2a

Toshiba Network Evolution Communications Hub

NE Communications Hub Datasheet

SMCH092

Version 1.0

24th October 2023

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2) Document Overview

2.1) Toshiba Document control

TOSHIBA	Document Title: **NE Communications Hub Datasheet**	Document Number: SMCH092	Version: 0.12
	Document Type: Design	Classification: **Confidential**	
	Review Date: 24th October 2023	Status: **Approved**	
	Approved by: Richard Taylor, Operations Direct, NE CH&N Programme Peter Hewson: Technical Design Authority, TEUR	Document Owner: TDA, TEUR	

2.1.1) Document Control

Review Period	Annually		**Retention Period**	12 months
Disposal	**Hard Copy**	e.g. Destroy	**Soft Copy**	e.g. Destroy
Master Location	**Hard Copy**	None	**Soft Copy**	Toshiba SharePoint

2.2) Document Details

Title	**Communications Hub Design Specification**		
Business Area	Toshiba europé, M2M, Smart Metering, DCC NEP		
Review Cycle	Annual		
Originator / Author Technical Design Authority, Toshiba Europe	Peter Hewson	**Signature**	
Approved NEP Delivery Director, Toshiba Europe	Richard Taylor	**Signature**	

2.2.1) Revision History

Version	Date	Changed by	Changes
0.1	2-February-2023	Peter Hewson	Initial version – first draft population of data
0.2	3-February-2023	Peter Hewson	Updated following new data and internal team review
1.0	6-February-2023	Peter Hewson	First draft release to DCC.
0.4	1-March-2023	Peter Hewson	Following request, the version numbering reverted to 0.x and status reverted to Draft. Also, updated with more recent data from Toshiba HW teams in mostly Polar Plots, Radiation patterns, Isolation, Efficiency and Gain, VSWR for the antennae and RF data sets.
0.5	5-March-2023	Peter Hewson	Updated following Toshiba internal review
0.6	6-March-2023	Peter Hewson	Release version for 7th March 2023 release schedule. Released in draft form, V0.6, as per DCC request.
0.7	24-March-2023	Peter Hewson	Updated following DCC review comments
0.8	3-May-2023	Peter Hewson	Updated following further DCC review comments
0.9	13-September-2023	Peter Hewson	Updated to include latest (final) agreed and harmonised ODM data
0.10	29-September-2023	Peter Hewson/Roger King	Updated to include further ODM data
0.11	19-October-2023	Peter Hewson/Roger King	Updated to include latest ODM data and new artwork image added with compliance logos. Also, duplicate image of casing artwork image removed from General Specification and improved in section 8 (packaging and labelling).
0.12	24-October-2023	Peter Hewson	Correction of missed and newly introduced errors, And update of document properties.

2.2.2) CIRCULATION LIST (individual and role)

Name	Organisation/Role
Richard Taylor	Toshiba, DCC NEP Delivery Director
Lisa McGuire	Toshiba, Project Manager
DCC/CI	Matt Day
n/a	CFDA

2.2.3) CONTRIBUTOR LIST (individual and role)

Name	Organisation/Role
Pete Hewson	Toshiba Technical Design Authority
TSIP Team	SW Development team and SW test team
Jay Perumal	Toshiba HW Lead
Roger King	HW Expert

2.3) Purpose and scope

2.3.1) Document purpose

This DCC Network Evolution, Lot 2a, Communications Hub Datasheet sets out the key parametric data for the NE 4G/LTE Cat 1, cellular, dual band HAN Communications Hub.

The data contained herein characterises the NE CH in terms of its principal electrical, mechanical, physical parameters and presents images and drawings to support identification.

2.3.2) Document context

This document exists in context of other Network Evolution other related documents as listed in "Related Documents". This document is one of the high-level reference documents for the DCC Network Evolution Programme.

2.3.3) Authorised requests for change (Current log)

This log sets out the history of approved change requests that have resulted in updates to this CH Datasheet since its first release.

Request for Change Request ID	CHDS Release Version (as released to DCC)	Description including applicable HW/FW release range
None	None	None to date.

2.4) Identification

This section describes the set of Toshiba NE CH variants that exist and identifies specifically to which variant this CH Datasheet applies.

The CH Datasheet applies to a range of NE CH variants including:

- Production NE CH, 4G/LTE, Cat 1, Dual band Zigbee HAN initial DCC NE CH variant. This device contains product FW and production certificates, keys and configuration settings and is ready for operational use.
- Test, without debug, NE CH, 4G/LTE, Cat 1, Dual band Zigbee HAN initial DCC NE CH variant.
- Test, with debug, NE CH, 4G/LTE, Cat 1, Dual band Zigbee HAN initial DCC NE CH variant.
- Wired Instrumented Test Communications Hub (wired-ITCH), without debug, NE CH, 4G/LTE, Cat 1, Dual band Zigbee HAN initial DCC NE CH variant.
- Wireless Instrumented Test Communications Hub (wireless-ITCH), without debug, NE CH, 4G/LTE, Cat 1, Dual band Zigbee HAN initial DCC NE CH variant.

2.4.1) NE Communications Hub variants

Toshiba provide multiple variants of the NE CH, the primary variants of which are summarised below.

The derivative versions all have different FW images installed to provide test, diagnostic and analysis focused devices that are not used in the operational environment. These devices do not have

production certificates, keys and configuration settings and may include additional code to support debug or instrumentation that means the actual variant performance will not be identical to, but is representative of and functionally equivalent to, production NE CHs.

The other NE CH variants derived from and sharing the same baseline HW as described in this CH Datasheet include:

- Test, without debug, NE CH, 4G/LTE, Cat 1, Dual band Zigbee HAN initial DCC NE CH variant.
- Test, with debug, NE CH, 4G/LTE, Cat 1, Dual band Zigbee HAN initial DCC NE CH variant.
- Wired Instrumented Test Communications Hub (wired-ITCH), without debug, NE CH, 4G/LTE, Cat 1, Dual band Zigbee HAN initial DCC NE CH variant.
- Wireless Instrumented Test Communications Hub (wireless-ITCH), without debug, NE CH, 4G/LTE, Cat 1, Dual band Zigbee HAN initial DCC NE CH variant.

Note, where a derivative variant disables a feature, e.g. the NE WAN antenna, then none of the relevant data in the CH Datasheet will apply.

2.4.2) Specific NE CH variant for this CH Datasheet

This section identifies the specific NE CH variant to which this datasheet applies.

This CH Datasheet applies to the baseline HW designed for the Production NE CH, 4G/LTE, Category 1, Band 20 and Band 28, dual band Zigbee HAN variant.

All other variants described above share the same HW as described for the primary Production variant.

2.5) Related documents

The following table lists the key related documents that set the compliance context for this Toshiba NE CH. The requirements trace matrix should be used to trace to contractual obligation and any additional external specification dependencies:

Name	Version	Date	Author/Source
[CHTS] - Communications Hub Technical Specification	V1.5	4-Nov-2021	https://smartenergycodecompany.co.uk/download/37640
[SMETS2] - Smart Metering Equipment Technical Specifications 2	V5.1	4-Nov-2021	https://smartenergycodecompany.co.uk/download/37637
[GBCS]- Great Britain Companion Specification	V4.1	4-Nov-2021	https://smartenergycodecompany.co.uk/download/37634
[ICHIS] - Intimate Communications Hub Interface Specification	V2.3	1-Jun-2021	ichis-v23.pdf (smartdcc.co.uk)
[JTM - Joint HAN RADIO Testing Methodology	V3.4	21-Jun-2020	joint_han_radio_testing_methodology_v34.pdf (smartdcc.co.uk)

Name	Version	Date	Author/Source
Zigbee Specification Revision 22	V22	19-Apr-2017	https://groups.csa-iot.org/wg/members-all/document/12571
[SEP] Zigbee Smart Energy (ZSE) Profile Specification	V1.4	14-Jun-2017	https://groups.csa-iot.org/wg/members-all/document/12798

2.6) Glossary

Abbreviation	Description
4G	4th Generation of the mobile network
CH	Communications Hub
CHDS	Communications Hub Detailed Specification
CHTS	Communications Hub Technical Specification
DCC	Smart Data Communication Company
ECDSA	Elliptic Curve Digital Signing and Signature Verification Algorithms
E-UTRA -	Evolved Universal Terrestrial Radio Access
ESME	Electricity Smart Meter Equipment
FOTA	Firmware updates Over The Air
GBCS	Great Britain Companion Specification
GPF	Gas Proxy Function
GSME	Gas Smart Meter Equipment
GUID	Global Unique IDentifier
HAN	Home Area Network
HHT	Hand Held Terminal
ICH	Intimate Communications Hub
IHD	In Home Display
LTE	Long Term Evolution
NE CH	Network Evolution Communications Hub
NE WAN	Network Evolution Wide Area Network
OTA	Over the Air (as in RF power measurements)
PIFA	Planar Inverted-F Antenna
PPMID	Prepayment Interface Device
SEC	Smart Energy code Company
SEP	Smart Energy Profile
SMETS2	Smart Metering Equipment Technical Specification V2
SoC	System on a Chip
TCP	Transmission Control Protocol
WAN	Wide Area Network

2.6.1) Key Validated Assumptions

The following key assumptions are made:

The term Band 28 refers to the use of the Ofcom allocations in the 700MHz spectrum but excludes the supplementary downlink band, i.e. Band 28 is assumed to be: 703-733MHz uplink and 758-788MHz downlink.

2.6.2)

3) General Data for NE CH, 4G/LTE, Cat 1, Dual band HAN variant

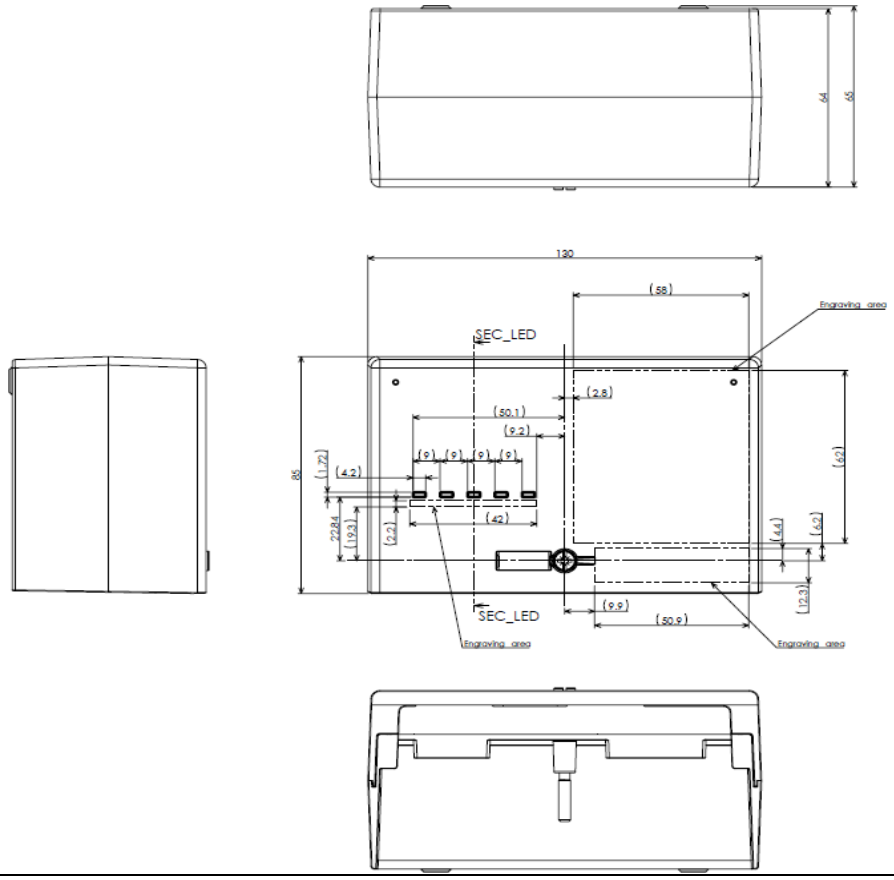
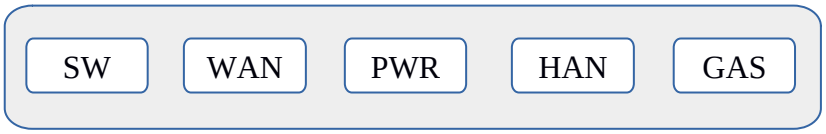
3.1) General summary data specification

Variant	NE 4G/LTE, Band 20 (800MHz) and Band UK 28 (700MHz) cellular with dual-band ZigBee Communication Hub
Colour	RAL: 9002
Size [mm]	W130 x D65 x H85
Weight [g] unboxed	270 +/- 15g
Deployment	Intimate Communications Hubs with ICHIS interface.
External Interface	ICHIS interface: External USB port for diagnostics and reverse logistic processes (e.g. test and sanitisation). Uses CSP pins in the ICHIS interface (NB data connectivity is only possible when in Test Bench Mode and connected to a authenticated Test Bench.)
Power input	12VDC (9.0V to 15.0V)
WAN interface	Cellular (LTE/4G) Category 1, E-UTRA, optimised for Band 20 (800MHz band) and Band 28 (700MHz).
Integral antenna for WAN	Yes.
Antenna port for WAN	None.
HAN interface	Dual-band IEEE 802.15.4 ZigBee: sub-GHz (868MHz) and 2.4GHz 16 channels from channel-11 to channel-26, 2405MHz to 2480MHz.
Integral antenna for HAN	Yes.
Operating Temperature	-20 to +55° C
Storage Temperature	-25 to +70° C
Operating Humidity	10 to 95 % RH
Power Consumption	Peak: not exceeding 6W. Average in Normal Operation: not exceeding 1W.
Ingress Protection	IP53
Fire Retarding capability / Flammability	UL 94 (PCBA and Plastics Case).
EMC Electro Magnetic Compatibility	BS EN 61000-6-3: Electromagnetic compatibility (EMC) - Generic standards. Emission standard for equipment in residential environments.
Design lifetime [Years]	15

3.2) Real time clock accuracy

The RTC accuracy of the modem is 24ppm.
Expected time drift per day of the clock design is 2.04s per day.
A forced time sync command should be used every 4 days maximum to limit clock drift to 8.16s.

3.3) Physical specification data

Design feature	Specification
Case drawings	
Dimensions (mm)	Height from bottom face: 85mm Height from ICHIS datum: 73.2mm Depth: 65 mm Width: 130 mm Note: Protruding part(s) not included
Visual Indicators	 All LEDs emit green light.

Design feature	Specification
ICHI Connector pin assignments	DC power connection:

Pin Number	Function	Pin Number	Function
1	DC - +12V	2	DC - +12V
3	DC - Common	4	DC - Common

Pin arrangement and electrical features in the DC and signalling connector for 4G Cellular DB variant.

Pin #	Name	Symbol	Function
1	+12V	+12V	12V DC power supply rail
2	+12V	+12V	12V DC power supply rail
3	Common	COM	Common DC power supply rail
4	Common	COM	Common DC power supply rail
5	Device Present	CH_PR	Active low (CH present)
6	Host Present	MT_PR	Active low (Host Present)
7	Reserved	NC	
8	Reserved	NC	
9	Reserved	NC	
10	USB Data +	CSP_A	USB differential Data (+).
11	USB Data -	CSP_B	USB differential Data (-).
12	Device Type Detection#1	CSP_C	I/F type detection pin1 (L: pull down/ H: pull up).
13	Reserved	NC	
14	Reserved	NC	
15	Reserved	NC	
16	Reserved	NC	
17	Reserved	NC	
18	Reserved	CSP_D	Not used
19	Reserved	CSP_E	Not used
20	USB VBUS	CSP_F	USB power (+5V)

Design feature	Specification
External Connections	None when connected to host ESME.
Weight (g)	Approx. 270 +/-15g
Ingress Protection	IP53
Fire Retarding capability / Flammability	UL 94 (PCBA and Plastics Case).
Operating Temperature Storage Temperature Operating Humidity	-20 to +55° C -25 to +75° C 10 to 95 % RH

4) RF general data

4.1) Radio interfaces, general data

This section describes the main specification and performance of the NE CH's three radio interfaces: 4G/LTE cellular SM WAN (Band 20 (800MHz) and Band 28 (700MHz)), dual band ZigBee SM HAN at 2.4GHz and sub-GHz (868MHz band):

Interface	Main details for interface
4G/LTE cellular, NE WAN	LTE/4G Band 20, "800MHz" band. Frequency Range: 832 – 862MHz Up-Link/ 791 – 821MHz Down-Link Width of Band: 30MHz Channel Plan FDD (Frequency Division Duplex) TRP greater than or equal to +18dBm TRS less than or equal to -91dBm
	LTE/4G Band 28, "700MHz" band. Frequency Range: 703 – 733MHz UL, 758 – 788MHz DL Width of Band: 30MHz Channel Plan FDD (Frequency Division Duplex). TRP greater than or equal to +18 dBm TRS less than or equal to -91 dBm

Interface	Main details for interface
Dual band ZigBee SM HAN	Certified by ZigBee Alliance / Connectivity Standards Alliance (csa-iot.org) for HW and Smart Energy Profile version 1.4 compliant Firmware. Dual-band, IEEE 802.15.4 ZigBee: sub-GHz (868MHz band) and 2.4 GHz. 2.4GHz: 16 channels from 2405MHz to 2480MHz (channel 11 to channel 26), European 2.4 GHz ISM band. Sub-GHz: Configurable by channel masks 863-876MHz band (channels 0 to 63). Channel bandwidth 200kHz. GB FSK. Note: 915-921MHz not supported in accordance with GBCS and JTM v3.4. ERC Recommendation 70-03 and ETSI EN 300 328. Supports Interface Requirement 2030 (IR20 30). Meets the MAPL criteria for Sub GHz band and 2.4 GHz band as defined in JTM v3.4 document: 2.4GHz TRP greater than or equal to +8dBm TRS less than or equal to -95dBm Sub-GHz TRP greater than or equal to +9dBm TRS less than or equal to -97dBm

4.2) ZigBee Sub-GHz, 915-921MHz Channels

In accordance with GBCS and JTM v3.4 the ZigBee 915MHz – 921MHz band is not implemented in the NE CH.

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5) Noise limits and spectrum analyser settings

5.1) Noise Limit

Interface	Frequency range(MHz)	Noise limit above the background noise (dB)
Band 20, (800MHz) 4G/LTE , Category 1, Cellular	832 – 862MHz UL 791 – 821 MHz DL	Less than or equal to 3.0
Band 28, (700MHz) 4G/LTE , Category 1, Cellular	703 - 733 MHz UL 758 - 788 MHz DL	Less than or equal to 3.0
ZigBee 2.4 GHz	2400 – 2483.5MHz	Less than or equal to 3.5
ZigBee Sub GHz	863 – 876MHz	Less than or equal to 5.0

5.2) Spectrum Analyser setting suggestions

Spectrum Analyser setting suggestions	
E-UTRA on LTE band 20, DL.	
Frequency Range	791 – 821 MHz DL
Attenuation	Set to the minimum value to lower the noise floor of the spectrum.
Internal Pre-amp	Turn on the internal pre-amplifier to lower the noise floor of the spectrum.
RBW	200kHz
VBW	500kHz
Detector Type	Average detector
Frequency Sweep Segments (MHz)	791-796, 796-801, 801-806, 806-811, 811–816, 816-821
Sweep Time	At least (5/0.2) × 5 = 125 seconds per frequency sweep segment
Marker Function	Marker noise

Spectrum Analyser setting suggestions	
E-UTRA on LTE Band 28, DL.	
Frequency Range	758 – 788MHz DL
Attenuation	Set to the minimum value to lower the noise floor of the spectrum.
Internal Pre-amp	Turn on the internal pre-amplifier to lower the noise floor of the spectrum.
RBW	200kHz
VBW	500kHz
Detector Type	Average detector
Frequency Sweep Segments (MHz)	758-763, 763-768, 768-773, 773-778, 778-783, 783-788
Sweep Time	At least (5/0.2) × 5 = 125 seconds per frequency sweep segment
Marker Function	Marker noise

5.3) Spectrum Analyser settings - ZigBee

Spectrum Analyser setting suggestions	
ZigBee 2.4GHz	
Frequency Range	2400.00 MHz–2483.50 MHz
Attenuation	Set to the minimum value to lower the noise floor of the spectrum.
Internal Pre-amp	Turn on the internal pre-amplifier to lower the noise floor of the spectrum.
RBW	2MHz
VBW	5MHz
Detector Type	Average detector
Frequency Sweep Segments (MHz)	1: 2400-2420 2: 2420-2440 3: 2440-2460 4: 2460-2483.5
Sweep Time	At least (20/2) × 5 = 50 seconds for segment 1–3 and at least (24/2) × 5 = 60 seconds for segment 4.
Marker Function	Marker noise.

Spectrum Analyser setting suggestions	
ZigBee Sub-GHz	
Frequency Range	863 MHz–876 MHz
Attenuation	Set to the minimum value to lower the noise floor of the spectrum.
Internal Pre-amp	Turn on the internal pre-amplifier to lower the noise floor of the spectrum.
RBW	200kHz
VBW	500kHz
Detector Type	Average detector
Frequency Sweep Segments (MHz)	1: 863 – 868 2: 868 – 873 3: 873 – 876
Sweep Time	At least (5/0.2) × 5 = 125 seconds for segment 1–2 and at least (3/0.2) × 5 = 75 seconds for segment 3.
Marker Function	Marker noise.

6) Antennae performance

6.1) Isolation

This section provides a summary of antenna isolation for ZigBee (both bands) and Cellular (both frequency ranges). Isolation is measured between pairs of radio antennae at the operating frequency bands. Isolation is required between radios to prevent desensitising of receivers when the peer radios are transmitting. Desensitising can lead to an increased error rate; this can also manifest itself with data packet collisions.

Band	LTE B20	LTE 28	Zigbee 2.4GHz	Zigbee Sub-GHz
LTE B20	-	-	Less than or equal to -20dB	Less than or equal to -14dB
LTE B28	-	-	Less than or equal to -20dB	Less than or equal to -15dB
Zigbee 2.4GHz	Less than or equal to -20dB	Less than or equal to -20dB	-	Less than or equal to -16dB
Zigbee-Sub-GHz	Less than or equal to -14dB	Less than or equal to -15dB	Less than or equal to -16dB	-

6.2) Antenna Design Specification

	Band 20, 28	ZigBee 2.4GHz	ZigBee Sub-GHz
Type	PIFA	PIFA	PIFA
Gain	Greater than or equal to -4.5dB	Greater than or equal to -4.0dB	Greater than or equal to -4.0dB
Polarisation	Vertical	Vertical	Vertical
Bandwidth	703MHz-862MHz	2405MHz-2480MHz	863MHz-876MHz
VSWR	Less than 3	Less than 3	Less than 3

7) Power Outage capability

This section provides a summary of the power stand up time to support power outage and restore scenarios.

When the power supply input is lost due to a power outage, the NE CH initiates its Last Gasp operation and temporarily draws power from an electrical charge held within the super capacitors. The stand-up time provided by the NE CH is greater than or equal to 208s (3m 28s).

The dedicated charge circuit ensures that the current consumption limits of the CH are not exceeded, the charging time sufficient for Zigbee and system start is approx. 50s.

8) Packaging and labelling

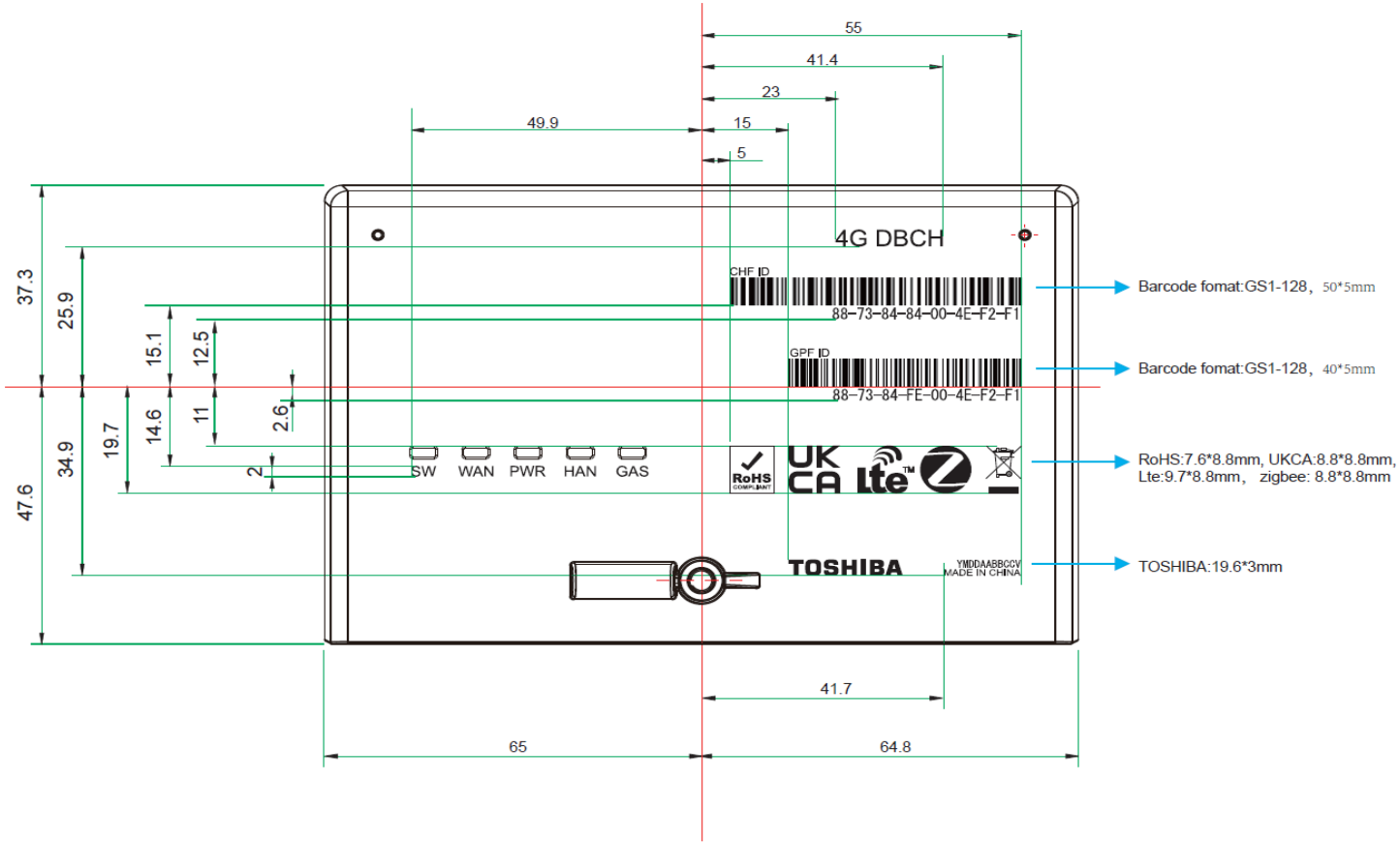


Figure 1 - Artwork for 4G DBCH

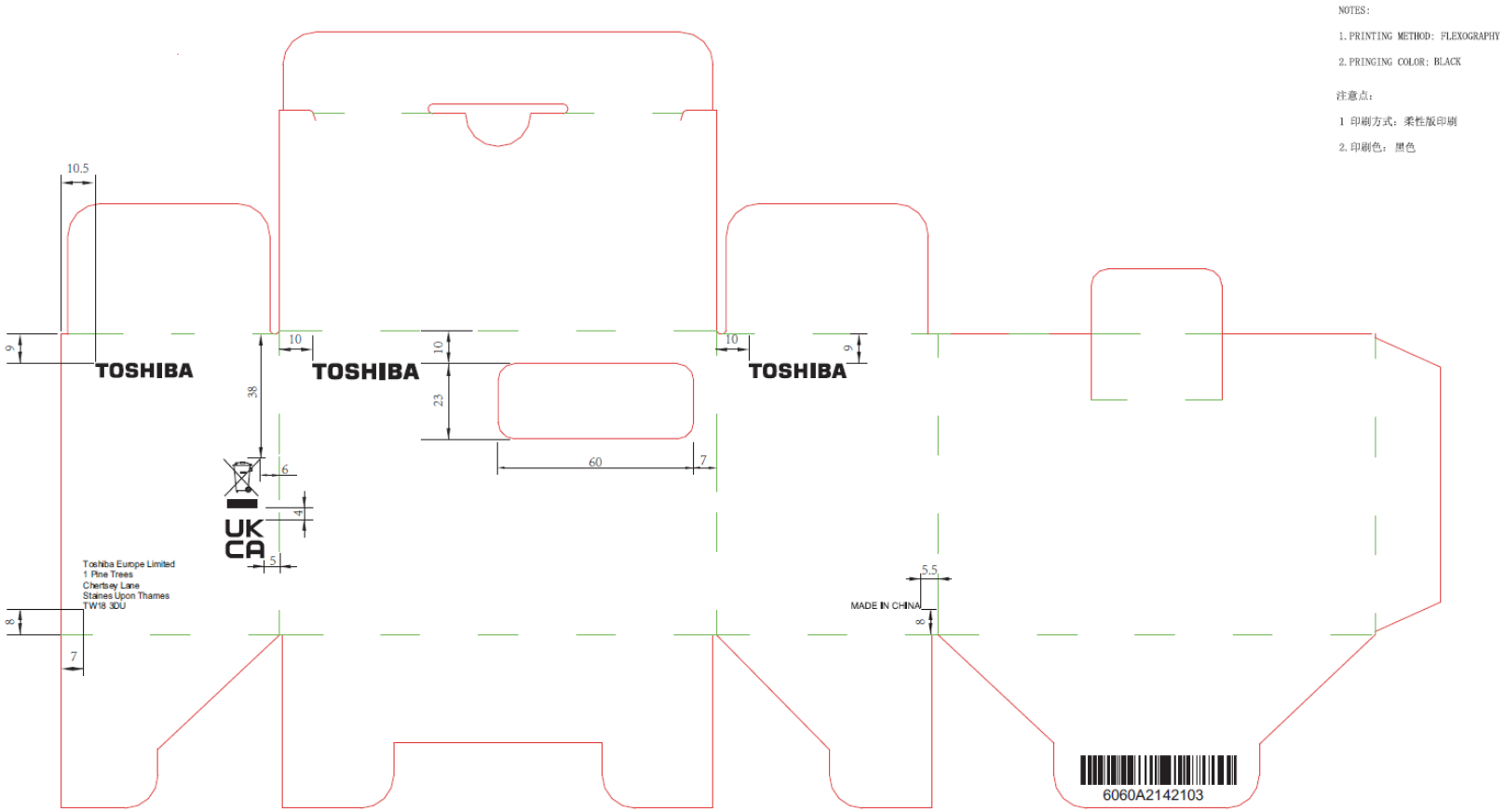
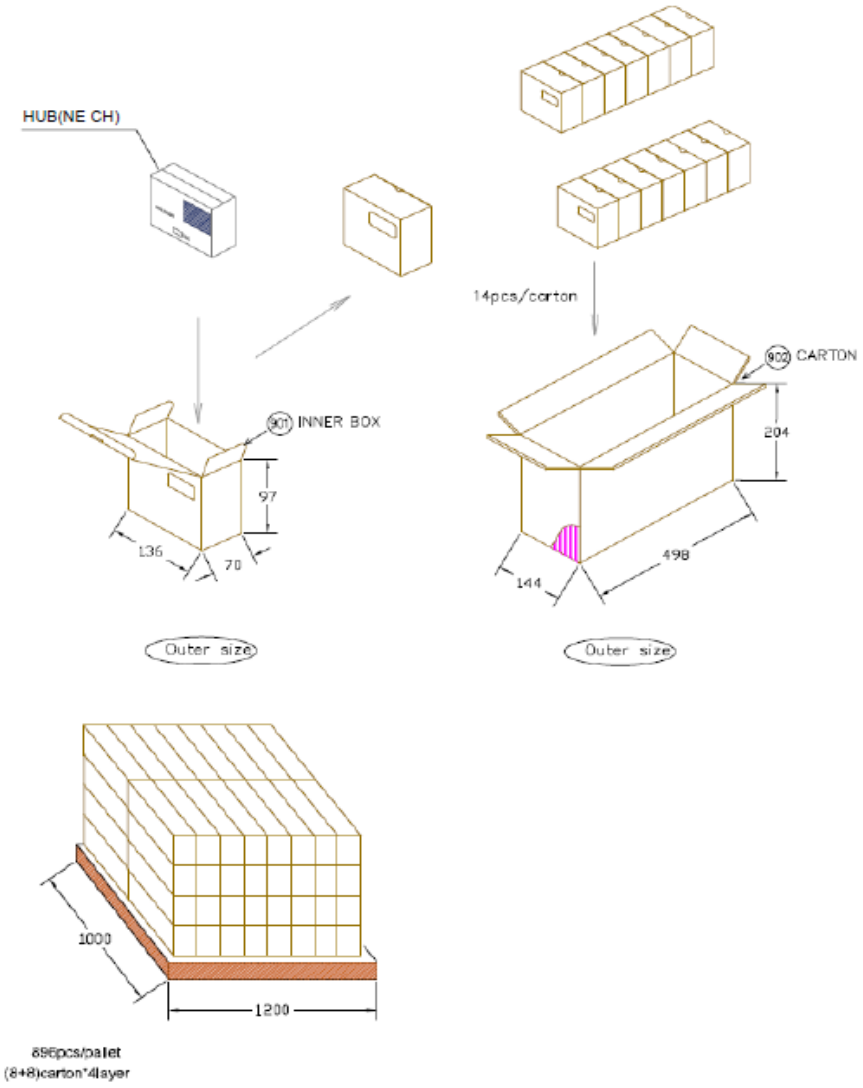


Figure 2 - Artwork for carton

Packaging	

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