



CMP40x0
Hostless Dual-Band Wi-Fi + BLE Module
Datasheet

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TRANSCEIVER IC

The CMP40x0, utilizing the Realtek RTL8721x SoC, is a WiFi+Bluetooth combo device with dual-integrated MCU cores. This module supports WiFi- and Bluetooth communications while hosting the end-user application. The architecture is optimized for low-power consumption. Customers can select from several supported RTOS implementations and also interface to a variety of peripherals or external MCUs.

The CMP4010 uses the RTL8721C and supports 2.4 GHz WiFi.
The CMP4020 uses the RTL8721D and supports 2.4 / 5 GHz WiFi.

INTEGRATED FLASH

The CMP40x0 incorporates 16 Mbit of additional SPI flash for storing program code and Over-The-Air code updates. The flash is managed by the core SoC SPI Flash Controller (SPIC) and is accessible by both MCU cores in the CMP40x0.

ABSOLUTE MAXIMUM RATINGS

Description	Min	Max	Unit
Storage temperature range	-40	125	°C
Power supply voltage (VDD)	3.0	3.6	V
I/O supply voltage	0.99	3.6	V

* VDD = Terminal Supply Domain

RECOMMENDED OPERATING CONDITIONS

Description	Min	Typ	Max	Unit
Operating temperature range	-40	-	85	°C
Power supply voltage (VDD)	3.0	-	3.6	V

POWER CONSUMPTION

(@25°C unless otherwise specified)

Operation Mode	Scenario	Min	Typical	Max	Unit
Deep Sleep	RTC Timer; 1 kB RAM retention	7	7.5	8	uA
Sleep	KM4 Power Gate; KM0 Clock Gate All RAM retained; WiFi retained	30	40	50	uA
Active	HT20 MCS0-7 Normal Mode KM4 Active Mode Rx Idle	-	52	-	mA
	HT20 MCS0-7 ULP Mode KM4 Active Mode Rx Idle	-	35	-	
	HT20 MCS0-7 ULP Mode KM4 Active Mode UDP Rx @ 8 Mbps	-	39	-	
WoWLAN Beacon	Rx Beacon Normal Mode KM4 Sleep Mode	-	28	-	mA
	Rx Beacon ULP Mode KM4 Sleep Mode	-	23	-	
WoWLAN DTIM=1	KM4 Sleep Mode; SRAM Retained WiFi Retained	700	750	800	uA

Transmit Mode	Typical (2.4 GHz)	Typical (5 GHz)	Unit
MCS7/HT20 – 18 dBm Tx	248	308	mA
MCS7/HT40 – 18 dBm (2.4 GHz) / 17 dBm (5 GHz)	247	310	mA
OFDM 54 Mbps – 19 dBm (2.4 GHz) / 18 dBm (5 GHz)	262	323	mA
CCK 11 Mbps – 18 dBm	257	n/a	mA

Bluetooth Operation Mode	Condition	Typical	Units
TX – KM4 and M0 ON	4.5 dBm TX	100	mA
RX – KM4 and M0 ON	Central Mode	56.1	mA
ADV – KM4 and M0 ON	Peripheral Mode	56.2	mA
Connection	Central Mode	56.3	mA

Wi-Fi 2.4 GHz Band RF Receiver Specifications

(@25°C unless otherwise specified)

Parameter	Description	Min	Typ	Max	Unit
Frequency Range	Center Channel Frequency	2412	-	2484	MHz
RX Sensitivity	1 Mbps CCK	-99.1	-98.6	-97.5	dBm
	2 Mbps CCK	-97	-95.9	-95.5	
	5.5 Mbps CCK	-94.5	-94.2	-93.5	
	11 Mbps CCK	-91.5	-91.1	-90.6	
RX Sensitivity	BPSK rate 1/2, 6 Mbps OFDM	-96	-95.4	-94.3	dBm
	BPSK rate 3/4, 9 Mbps OFDM	-94.5	-94.3	-93.9	
	QPSK rate 1/2, 12 Mbps OFDM	-93	-92.9	-92.5	
	QPSK rate 3/4, 18 Mbps OFDM	-91	-90.4	-90	
	16QAM rate 1/2, 24 Mbps OFDM	-87	-86.8	-86.4	
	16QAM rate 3/4, 36 Mbps OFDM	-84	-83.8	-83.4	
	64QAM rate 1/2, 48 Mbps OFDM	-79.5	-79.2	-78.9	
	64QAM rate 3/4, 54 Mbps OFDM	-78.1	-77.8	-77	
RX Sensitivity BW = 20 MHz Mixed Mode 800 ns Guard Interval Non-STBC	MCS 0, BPSK rate 1/2	-95.5	-95.1	-94.1	dBm
	MCS 1, QPSK rate 1/2	-92.2	-92	-91.7	
	MCS 2, QPSK rate 3/4	-90	-89.4	-89	
	MCS 3, 16QAM rate 1/2	-86.5	-85.8	-84	
	MCS 4, 16QAM rate 3/4	-83.2	-82.9	-82.5	
	MCS 5, 64QAM rate 2/3	-78.5	-78.4	-78	
	MCS 6, 64QAM rate 3/4	-77	-76.7	-76.4	
	MCS 7, 64QAM rate 5/6	-75.7	-75.4	-75	
RX Sensitivity BW = 40 MHz Mixed Mode 800 ns Guard Interval Non-STBC	MCS 0, BPSK rate 1/2	-93	-92.5	-92.2	dBm
	MCS 1, QPSK rate 1/2	-89.5	-88.7	-87	
	MCS 2, QPSK rate 3/4	-87	-86.5	-86.4	
	MCS 3, 16QAM rate 1/2	-83.5	-83.3	-83	
	MCS 4, 16QAM rate 3/4	-80	-79.9	-79	
	MCS 5, 64QAM rate 2/3	-75.5	-75.4	-75	
	MCS 6, 64QAM rate 3/4	-74.5	-74	-73.9	
	MCS 7, 64QAM rate 5/6	-73	-72.5	-72.3	
Maximum Receive Level	6 Mbps OFDM	-	0	-	dBm
	54 Mbps OFDM	-	0	-	
	MCS 0	-	0	-	
	MCS 7	-	0	-	
Receive Adjacent Channel Rejection	1 Mbps CCK	42	43	44	dBm
	11 Mbps CCK	39	41	42	
	BPSK rate 1/2, 6 Mbps OFDM	39	40	41	
	64QAM rate 3/4, 54 Mbps OFDM	20	22	24	
	HT20, MCS 0, BPSK rate 1/2	39	39	40	
	HT20, MCS 7, 64QAM rate 5/6	19	20	21	
	HT40, MCS 0, BPSK rate 1/2	27	29	32	
	HT40, MCS 7, 64QAM rate 5/6	9	10	11	

Wi-Fi 2.4 GHz Band RF Transmitter Specifications

(@25°C unless otherwise specified)

Parameter	Description	Min	Typ	Max	Unit
Frequency Range	Center Channel Frequency	2412	-	2484	MHz
Output power with spectral mask and EVM compliance	1 Mbps CCK	-	18	-	dBm
	11 Mbps CCK	-	18	-	
	BPSK rate 1/2, 6 Mbps OFDM	-	17	-	
	64QAM rate 3/4, 54 Mbps OFDM	-	17	-	
	HT20, MCS 0, BPSK rate 1/2	-	16	-	
	HT20, MCS 7, 64QAM rate 5/6	-	16	-	
	HT40, MCS 0, BPSK rate 1/2	-	16	-	
	HT40, MCS 7, 64QAM rate 5/6	-	16	-	
TX EVM	BPSK rate 1/2, 6 Mbps OFDM	-	-	-5	dBm
	64QAM rate 3/4, 54 Mbps OFDM	-	-	-25	
	HT20, MCS 0, BPSK rate 1/2	-	-	-5	
	HT20, MCS 7, 64QAM rate 5/6	-	-	-28	
	HT40, MCS 0, BPSK rate 1/2	-	-	-5	
	HT40, MCS 7, 64QAM rate 5/6	-	-	-28	
Output Power Variation	After Power Trim	-1.5	-	1.5	dBm
Carrier Suppression Harmonic Output Power	1 st Harmonic	-	-	-30	dBm
	2 nd Harmonic	-	-23	-21.9	
	3 rd Harmonic	-	-15	-14	

Wi-Fi 5 GHz Band RF Receiver Specifications

(@25°C unless otherwise specified)

Parameter	Description	Min	Typ	Max	Unit
Frequency Range	Center Channel Frequency	5180	-	5825	MHz
RX Sensitivity	BPSK rate 1/2, 6 Mbps OFDM	-94.5	-93.6	-92	dBm
	BPSK rate 3/4, 9 Mbps OFDM	-93.5	-92.8	-91	
	QPSK rate 1/2, 12 Mbps OFDM	-92	-91.5	-90.5	
	QPSK rate 3/4, 18 Mbps OFDM	-90	-89.1	-88	
	16QAM rate 1/2, 24 Mbps OFDM	-86.5	-85.6	-84.5	
	16QAM rate 3/4, 36 Mbps OFDM	-83.5	-82.8	-82	
	64QAM rate 1/2, 48 Mbps OFDM	-79	-78.3	-77.5	
	64QAM rate 3/4, 54 Mbps OFDM	-77.5	-76.7	-76	
RX Sensitivity BW = 20 MHz Mixed Mode 800 ns Guard Interval Non-STBC	MCS 0, BPSK rate 1/2	-94	-93.3	-91.5	dBm
	MCS 1, QPSK rate 1/2	-91.5	-90.7	-89.5	
	MCS 2, QPSK rate 3/4	-89	-88.2	-87	
	MCS 3, 16QAM rate 1/2	-86	-85	-84	
	MCS 4, 16QAM rate 3/4	-82.6	-81.9	-80.5	
	MCS 5, 64QAM rate 2/3	-78	-77.1	-76	
	MCS 6, 64QAM rate 3/4	-76.5	-75.4	-74	
	MCS 7, 64QAM rate 5/6	-74.8	-73.7	-72.5	
RX Sensitivity BW = 40 MHz Mixed Mode 800 ns Guard Interval Non-STBC	MCS 0, BPSK rate 1/2	-91.5	-90.6	-88.5	dBm
	MCS 1, QPSK rate 1/2	-88.5	-87.8	-86.5	
	MCS 2, QPSK rate 3/4	-85.5	-85.2	-83.5	
	MCS 3, 16QAM rate 1/2	-82.5	-82.1	-81	
	MCS 4, 16QAM rate 3/4	-79	-78.7	-78	
	MCS 5, 64QAM rate 2/3	-74.5	-74	-73	
	MCS 6, 64QAM rate 3/4	-73.5	-72.8	-72	
	MCS 7, 64QAM rate 5/6	-72	-71.3	-70.5	
Maximum Receive Level	6 Mbps OFDM	-	0	-	dBm
	54 Mbps OFDM	-	0	-	
	MCS 0	-	0	-	
	MCS 7	-	0	-	
	BPSK rate 1/2, 6 Mbps OFDM	19	21	23	
	64QAM rate 3/4, 54 Mbps OFDM	10	11	12	
	HT20, MCS 0, BPSK rate 1/2	19	19	20	
	HT20, MCS 7, 64QAM rate 5/6	7	7	9	
	HT40, MCS 0, BPSK rate 1/2	29	30	31	
	HT40, MCS 7, 64QAM rate 5/6	11	13	14	

Wi-Fi 5 GHz Band RF Transmitter Specifications

(@25°C unless otherwise specified)

Parameter	Description	Min	Typ	Max	Unit
Frequency Range	Center Channel Frequency	5180	-	5825	MHz
	BPSK rate 1/2, 6 Mbps OFDM	-	17	-	
	64QAM rate 3/4, 54 Mbps OFDM	-	16	-	
	HT20, MCS 0, BPSK rate 1/2	-	16	-	
	HT20, MCS 7, 64QAM rate 5/6	-	15	-	
	HT40, MCS 0, BPSK rate 1/2	-	16	-	
	HT40, MCS 7, 64QAM rate 5/6	-	15	-	
TX EVM	BPSK rate 1/2, 6 Mbps OFDM	-	-	-5	dBm
	64QAM rate 3/4, 54 Mbps OFDM	-	-	-25	
	HT20, MCS 0, BPSK rate 1/2	-	-	-5	
	HT20, MCS 7, 64QAM rate 5/6	-	-	-28	
	HT40, MCS 0, BPSK rate 1/2	-	-	-5	
	HT40, MCS 7, 64QAM rate 5/6	-	-	-28	
Output Power Variation	After Power Trim	-1.5	-	1.5	dBm
Carrier Suppression		-	-	-30	dBm

Bluetooth 2.4 GHz Band RF Tx/Rx Specifications

(@25°C unless otherwise specified)

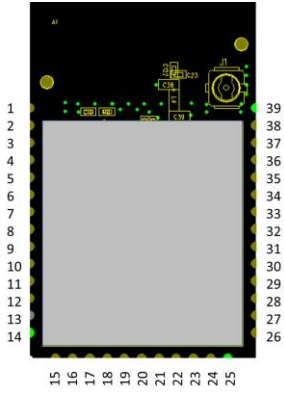
Parameter	Min	Typ	Max	Unit
Frequency Range	2402	-	2480	MHz
TX Power	-	4.5	-	dBm
RX Sensitivity (LE 1M PHY)	-100.9	-	-	dBm
RX Sensitivity (LE 2M PHY)	-96.8	-	-	dBm

I/O PIN ASSIGNMENTS

Refer to the RTL8721 datasheet for pin functionality details.

Module Pin Number	Pin Name	Notes
1	PA27	
2	PA30	
3	RREF/PA28	Adding a 12K pull down resistor enables HSUSB
4	HSDP/PA26	Either HSDP or GPIO PA26 depending on 12K pull down present or not
5	HSDM/PA25	Either HSDP or GPIO PA26 depending on 12K pull down present or not
6	PB1	
7	PB2	
8	PB3	
9	PB4	
10	PB5	
11	PB6	
12	PB7	
13	VCC	
14	GND	
15	FLASH SPI Data In	Pin not available as GPIO: Dedicated to Flash
16	NC	Pin isolated from Flash CLK
17	FLASH_SPI_CS	Pin not available as GPIO: Dedicated to FLASH
18	FLASH_SPI_Data Out	Pin not available as GPIO: Dedicated to FLASH
19	PB22	
20	PB23	
21	PB26	
22	PB29	
23	PB31	
24	PA0	
25	GND	
26	PA4	
27	PA2	
28	CHIP_ENABLE	
29	UART_LOG_TXD / PA7	This Pin pulled low with Reset applied placed device in Download Mode
30	UART_LOG_RXD / PA8	
31	PA19	
32	PA18	
33	PA17	
34	PA16	
35	PA15	
36	PA14	
37	PA12	
38	PA13	
39	GND	

MODULE PINOUT

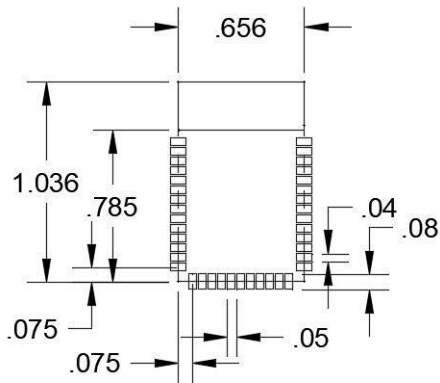


MODULE DIMENSIONS

1.036 x 0.656 x 0.142 in (16.7 x 26.3 x 3.6 mm)

MODULE LAND FOOTPRINT

Dimensions in inches.



EVALUATION BOARD

Part Number: CMP4010-1-EVB (Note host board cutout around antenna.)



PROCESSING

Recommended Reflow Profile

Parameter Values	
Ramp Up Rate (from T_{soakmax} to T_{peak})	3°/sec max
Minimum Soak Temperature	150°C
Maximum Soak Temperature	200°C
Soak Time	60-120 sec
T_{Liquidus}	217°C
Time above TL	60-150 sec
T_{peak}	250°C
Time within 5° of T_{peak}	20-30 sec
Time from 25° to T_{peak}	8 min max
Ramp Down Rate	6°C/sec max

Pb-Free Solder Paste

Use of “No Clean” soldering paste is strongly recommended, as it does not require cleaning after the soldering process.

Note: *The quality of solder joints on the castellations (“half vias”) where they contact the host board should meet the appropriate IPC Specification. See the Castellated Terminations Section in the latest IPC-A-610 Acceptability of Electronic Assemblies document.*

Cleaning

In general, cleaning the populated module is strongly discouraged. Residuals under the module cannot be easily removed with any cleaning process.

- Cleaning with water can lead to capillary effects where water is absorbed into the gap between the host board and the module. The combination of soldering flux residuals and encapsulated water could lead to short circuits between neighboring pads. Water could also damage any stickers or labels.
- Cleaning with alcohol or a similar organic solvent will likely flood soldering flux residuals into the two housings, which is not accessible for post-washing inspection. The solvent could also damage any stickers or labels.
- Ultrasonic cleaning could damage the module permanently.

The best approach is to consider using a “No Clean” solder paste and eliminate the post-soldering cleaning step.

Optical Inspection

After soldering the module to the host board, consider optical inspection to check the following:

- Proper alignment and centering of the module over the pads
- Proper solder joints on all pads
- Excessive solder or contacts to neighboring pads or vias

Repeating Reflow Soldering

Only a single reflow soldering process is encouraged for host boards.

Wave Soldering

If a wave soldering process is required on the host boards due to the presence of leaded components, only a single wave soldering process is encouraged.

Hand Soldering

Hand soldering is possible. When using a soldering iron, follow IPC recommendations (reference document *IPC-7711*).

Rework

The CMP4010 can be unsoldered from the host board. Use of a hot air rework tool should be programmable and the solder joint and module should not exceed the maximum peak reflow temperature of 250°C.

Caution

If temperature ramps exceed the reflow temperature profile, module and component damage may occur due to thermal shock. Avoid overheating.

Warning

Never attempt a rework on the module itself (i.e., replacing individual components); such actions will terminate warranty coverage.

Additional Grounding

Attempts to improve the module or the system grounding by soldering braids, wires or cables onto the module RF shield cover is done at the customer's own risk. The ground pins at the module perimeter should be sufficient for optimum immunity to external RF interference.

AGENCY CERTIFICATIONS (PCB ANTENNA ONLY)

The following certifications are in effect for CMP4010.

**Certifications PENDING for CMP4020

- FCC
- IC

FCC Compliance Statement Part 15.19, Section 7.15 of RSS-GEN

This device complies with Part 15 of the FCC Rules and with Industry Canada license-exempt RSS Standards. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Warning (Part 15.21)

Changes or modifications not expressly approved by CEL could void the user's authority to operate the equipment.

20 cm Separation Distance

To comply with FCC/IC RF exposure limits for general population/uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

OEM Responsibility to the FCC and IC Rules and Regulations

The CMP4010 has been certified per FCC Part 15 Rules and to Industry Canada license-exempt RSS Standards for integration into products without further testing or certification. To fulfill the FCC and IC Certification requirements, the OEM of the CMP4010 must ensure that the information provided on the CMP4010 label is placed on the outside of the final product. The CMP4010 is labeled with its own FCC ID Number and IC ID Number. If the FCC ID and the IC ID are not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. The exterior label can use wording such as the following:

"Contains Transmitter Module FCC ID: W7Z- WB242102" or "Contains FCC ID: W7Z- WB242102"

"Contains Transmitter Module IC: 8254A- WB242102" or "Contains IC: 8254A- WB242102"

The OEM of the CMP4010 may only use the approved antenna (PCB trace antenna) that has been certified with this module. The OEM of the CMP4010 must test their final product configuration to comply with Unintentional Radiator Limits before declaring FCC Compliance per Part 15 of the FCC Rules.

IC Certification — Industry Canada Statement ****PENDING****

The term "IC" before the certification/registration number only signifies that the Industry Canada technical specifications were met.

Certification IC - Déclaration d'Industrie Canada

Le terme "IC" devant le numéro de certification/d'enregistrement signifie seulement que les spécifications techniques Industrie Canada ont été respectées.

Section 14 of RSS-210

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population. Consult Safety Code 6, obtainable from Health Canada's website: <http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/index-eng.php>

L'article 14 du CNR-210

Le programme d'installation de cet équipement radio doit s'assurer que l'antenne est située ou orientée de telle sorte qu'il ne pas émettre de champ RF au-delà des limites de Santé Canada pour la population générale. Consulter le Code de sécurité 6, disponible sur le site Web de Santé Canada: <http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/index-eng.php>

ANTENNA

See Evaluation Board picture for example of host PCB cutout around antenna.

CEL's CMP4010 includes an integrated Printed Circuit Board (PCB) trace antenna. An optional configuration which uses a u.FI connector on the module allows the user to connect an external antenna. The CMP4010 has been certified with the PCB trace antenna only.

The PCB antenna employs a topology that is compact and highly efficient. To maximize range, an adequate ground plane must be provided on the host PCB. Correctly positioned, the ground plane on the host PCB will contribute significantly to the antenna performance (it should not be directly under the module PCB antenna). The position of the module on the host board and overall design of the product enclosure contribute to antenna performance. Poor design affects radiation patterns and can result in reflection, diffraction and/or scattering of the transmitted signal.

For optimum antenna performance, the CMP4010 should be mounted with the PCB trace antenna overhanging the edge of the host board. To further improve performance, a ground plane may be placed on the host board under the module; up to the antenna (a minimum of 1.5" x 1.5" is recommended). The installation of an uninterrupted ground plane on a layer directly beneath the module will also allow you to run traces under this layer. CEL can assist with your PCB layout.

The following are some design guidelines to help ensure antenna performance:

- Never place the ground plane or route copper traces directly underneath the antenna portion of the module
- Never place the antenna close to metallic objects
- In the overall design, ensure that wiring and other components are not placed near the antenna
- Do not place the antenna in a metallic or metalized plastic enclosure
- Keep plastic enclosures 1cm or more away from the antenna in any direction

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

ORDERABLE PART NUMBERS

Orderable Part Number	Description	Min/Mult
CMP4010-1-R	RTL8721C IC, Wi-Fi + BT combo, PCB antenna	600/600
CMP4010-1C-R	RTL8721C IC, Wi-Fi + BT combo, u.FI connector	600/600
CMP4010-1-EVB	Evaluation Board, RTL8721C IC, Wi-Fi + BT combo	1/1
CMP4020-1-R	RTL8721D IC, Dual Band Wi-Fi + BT combo, PCB antenna	600/600
CMP4020-1C-R	RTL8721D IC, Dual Band Wi-Fi + BT combo, u.FI connector	600/600
CMP4020-1-EVB	Evaluation Board, RTL8721D IC, Dual Band Wi-Fi + BT combo	1/1

REFERENCES

Reference Documents	Download
Health Canada Safety Code 6	Link

REVISION HISTORY

Revision	Changes to Current Version	Page(s)
0027-00-07-00-000 (Issue A) July 17, 2020	Initial Preliminary Data Sheet	N/A
0027-00-07-00-000 (Issue B) Sept 25, 2020	Add 'Reference Code Available' section. Add BLE Mesh capability.	1
0027-00-07-00-000 (Issue C) Oct 30, 2020	Update operational temperature range	4
0027-00-07-00-000 (Issue D) Apr 26, 2021	Add FCC/IC certification information. Update Orderable PN Table	12 15
0027-00-07-00-000 (Issue E) June 1, 2021	Change BLE Tx power. Correct PN in references to core SoC.	7
0027-00-07-00-000 (ISSUE F) May 23, 2022	Convert to CMP40x0; Add 5 GHz data for CMP4020	--
0027-00-07-00-000 (ISSUE G) JUNE, 2022	Clarify SPI FLASH Pin Assignments	10

DISCLAIMER

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