Honeywell

Honeywell Iterative Process

V200H

NB-IoT enabled Water meter Register

Production Test Specification

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Document Distribution List

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Modification History

Version	ECN	Date <mm/dd/yy>	Changes made	Author	Reviewers
Draft		02/07/2023	Initial Revision	Debprasad Das	Shalu S, Avinav S, Pradeep D, Harsha K, Piramanayagam S, Krishna M
1.0		27/03/2023	Added 24th March ICT test points, Battery soldering guideline from EVE, Removed EEPROM test clause and adjusted test sequence. Incorporated few review feedback	Debprasad Das	
1.1		06/09/2023	Updated PTS based on feedbacks from the meeting with Syrma dated 19th May 2023	Debprasad Das	
1.2		06/16/2023	Updated PTS based on feedbacks from Syrma visit dated 13th June 2023	Debprasad Das	
1.3		0813/2023	Updated the following 1. Test points and 2. Impedance Table 3. Voltages and tolerance 4. Standby Current 5. Sleep Current 6. TX Current 7. RSSI level 8. All the FW commands	Debprasad Das, Piramanayagam S, Rajinikanth Reddy	

1.4		12/08/2023	1. Added Note "to short W1 jumper before sending the device for warehouse to avoid deep discharge of super cap." on Test strategy section. 2. UART and IR interface baud rate modified to 9600. 3. In voltage rail check section added a Note on VDD_HALL measurement only to the specific variant. 4. Modem continuous on command 0x5F removed as per FW implementation 5. Magnetic tamper command 0x2D updated as per FW implementation 6. All the modem and RSSI commands in RF1 updated complete Frame as requested by Syrma 7. RSSI measurement process and commands updated 8. Pulse o/p test process and commands updated as per FW implementation 9. Alisa count CW command 0x2E and CCW command 0x2F updated as per FW implementation. 10. Sleep mode write and read command added as per implementation. 11. Syrma proposed PCBA label updated. 12. For register product label to be referred register label drawing no.	Debprasad Das	Piramanayagam S, Jefrin J, Ritesh N, Krishna M

1.5		11/04/2023	1. Updated the Document no for Modem Firmware document and NFC Protocol specifications. 2. Updated the test process for RTC clock accuracy measurement. 3. Modem FW version updated. 4. Enable JTAG Level-2 security moved before W1 and W2 jumper solder. 5. Pulse output test process has been updated as per latest FW implementation. 6. Added Device state change to sleep mode in FCT2 before potting. 7. Change back of Device state to Factory mode added in FCT3 8. RESET battery parameter added in FCT3. 9. SET RTC calibration Factor added in FCT3. 10. Remaining Battery life days has been updated to 5470 Days. 11. New PCBA label has been updated as per Syrma proposal document. 12. Updated Register product label drawing number 3014-2533-001. 13. Added a table for programming TPs and indicative marking from Gerber 14. New test point BT1.1 added as per REV1 PCB 15. Set PCB serial number modified from FCT3 to FCT1 as per Syrma suggestion	Debprasad Das	Piramanayagam S, Veerandra C, Jefrin J

1.6		23/04/2024	1. Added Firmware version check and checksum verification after loading V200H MCU Firmware. 2. Added Input voltage tolerance from external power supply ±0.05V. 3. Updated voltage range tolerance from ±5% to ±3% based on the data from initial pre-PPAP. 4. Temp range in PTS modified. Removed 1.5 from range. 5. A note added regarding -ve tab soldering of Battery and super cap in test strategy section. 6. Updated the standby and sleep current measurement process for average current measurement over 30 secs. 7. Standby current limit modified to 15-22uA and sleep current limit modified to 15-22uA. 8. Added commands for enabling 55555555555 on LCD display and reset back to 00000000000. 9. Updated the CW and CCW pulse count to 300±3. 10. Modem FW version updated. 11. Added CW and CCW pulse count check at FCT3.	Debprasad Das	Shalu S, Piramanayagam S, Avinav S, Rajinikanth P, Pradeep D

Rev A	00052366	07/25/2024	1. 1.6 Test strategy section for FCT2+RF1 statement updated as Register Cup and seals assembly after FCT2 testing 2. Clause 4.2.3: Removed 0x67 01 command as not implemented Limit defined 16 to 20.5uA 3. RTC Pass condition modified from +/-20 to +/-2PPM and for details refer notes at 4.2.5 4. Removed 4.2.7 Internal Temp test from FCT1 added the test at FCT3 4.5.8 with pre-defined temperature considered as reference temperature. 5. 4.2.8 Note 2 added – Hall sensor test to be disabled in the script 6. FCT2_RF1 limits defined for Band 8 (6 to 11 dBm), Band 3 (-3 to 2dBm) and current value 50 to 80mA. Band 3 Power and Band 3 RSSI testing sequence swapped. Added a note on the RF power ranges are without correction factor in CMW100. Added 5s power measurement, 50 samples max hold mode and 5 sec average current measurement. 7. Clause 4.3.7 & 4.5.7: Removed "-" for count in the defined limit. 8. Clause 4.3.9: Removed 0x67 01 command as not implemented, Limit defined 16 to 22uA. 9. Clause 4.3.12: Limit defined 3.62 to 3.68V	Debprasad Das Piramanayagams	Jefrin J, Mugesh H(Syrma). Shalu Singhvi, Peter D, Avinav Srivastav

			10. Clause 4.5.3: Command response updated to C6 00 11. Clause 4.5.4: Command response updated to 06 00 12. Clause 4.5.1: Limits defined for Band 8 (5 to 8dBm). Added command for modem to disable modem power at the end of RF test. Added a note on the RF power ranges are without correction factor in CMW100. Added 5s power measurement, 50 samples max hold mode and 5 sec average current measurement. 13. Updated V200H PCBA label and added Gear plate label at 6.1 & 6.2. 14. Removed sections 4.3.12 and 4.5.1 for the device state changes in FCT2 and FCT3 15. Added section 4.5.10 for Write register ID as per feedback from Staratura factory		

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1. Introduction

1.1 Objectives

V200H is a NB-IoT communication enabled water meter. This test artifact is intended to provide detailed test specifications for ICT, FCT and to build manufacturing test fixture for V200H water meter production. This document is a live document and will be updated as and when need arises. This will help EMS supplier to perform all the required testing.

1.2 Scope

This document serves the purpose of identifying the test specifications required for functional verification of the unit during various stages of production.

1.3 Definitions / Acronyms / Abbreviations

Abbreviations	Description
CTQ	Critical to Quality
DUT	Device Under Test
mV	Milli Volts
mA	Milli Amperes
dB	Decibel
dBm	Decibel milliwatts
HLC	Hybrid Layer Capacitor
ICT	In-Circuit Test
FCT	Functional Circuit Test
EOL	End of Line
MRD	Marketing Requirement Document

1.4 Reference Documents

Document Title	Document No	Attachments
V200H PWA	3012-6321-001	
V200H Schematic	3012-6315-001	
V200H PWB	3012-6319-001	
V200H Assembly Document	3012-6313-001	
Modem Firmware Document	51121780	
V200H Firmware Document	51121779	
NFC Protocol specifications	51121781	
*Please refer latest REV of document.		

1.5 Production Standards

In general, the standard IPC-A-610 for acceptability applies.
If not stated otherwise, the acceptance criteria for the assembly must meet class 2 requirements (IPC-A-610 1.4) at minimum.

1.6 Test Strategy

The test strategy consists of implementation of AOI (Automated optical inspection), Visual inspection, ICT (In-circuit test) and FCT (Functional Circuit Test).

AOI:
AOI must be done on each produced board.
Placement, proper soldering, and package type of all components shall be checked.
AOI coverage shall be 100%.

ICT:
ICT must be done on each produced board.
ICT coverage shall be 85% nets (Except Antenna Trace in RF Path) on the board.

FCT:
The functional tests are split in 3 sections:

FCT 1: Initial functional test of the board. Additionally measure the ambient temperature of the test setup.

FCT 2 + RF1: Functional tests and Modem radiated power test after assembly of battery, super cap, RF antenna and seal, LCD holder and LCD seal, NFC bobbin, pulse output cable & seal and followed by Register cup and seals assembly.

FCT 3 + RF2: After potting Register Functional tests and Radiated power tests after Leak test.

All functional tests must be done on each produced board.

During the FCT stages, if any device fails, the test retry will be done for maximum of 3 times and if the device fails the test 3 times, then the particular failed device needs to be separate out for investigation.

The serial number of register and PCBA to be mapped for traceability.

Remote access of real time production test data to be provided to Honeywell.

Caution: Solder the -ve tab for the battery and super cap first to prevent any discharge to the board while assembling.

1.7 Firmware

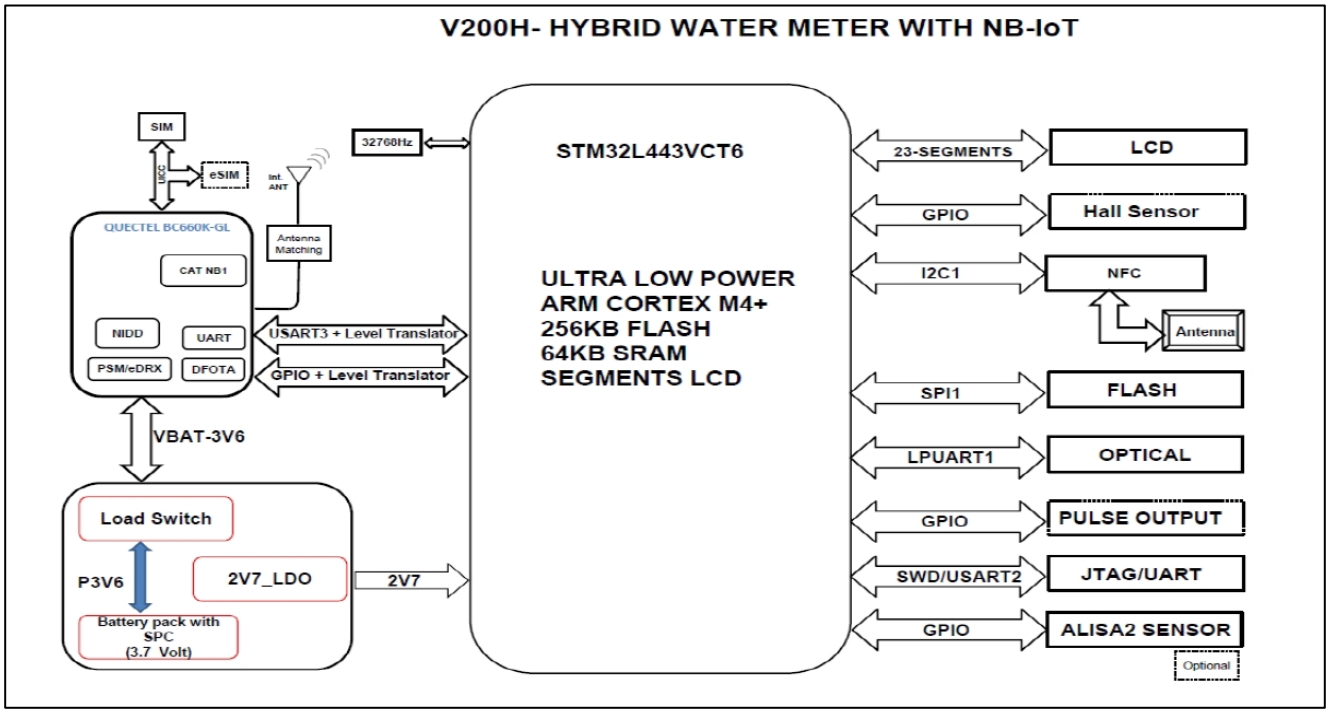
During production process firmware to be programmed as below.

1. To program MCU during FCT1 stage

The firmware is developed by Honeywell and provided to the EMS.

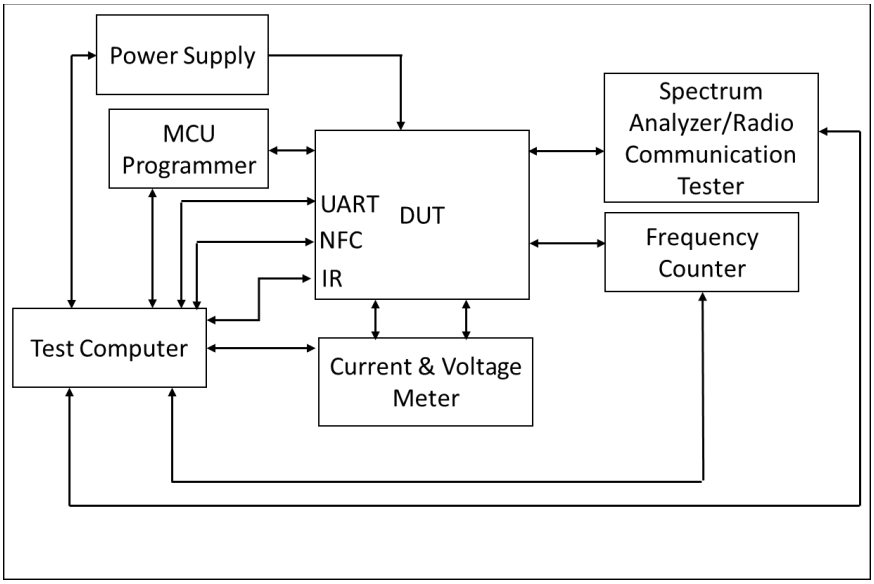
2. Test Concept

2.1 Hardware Block Diagram



2.2 FCT Hardware material requirements

This is a non-exhaustive list.



2.2.1 Test Bench

For all RF parameters in Radiated mode, use the RF Shielded box.
All test commands are sent by PC using Serial link via Isolated UART Cable between DUT and PC in FCT1, FCT2 & RF1 and FCT3, RF2 test commands are sent through NFC/ optical IR reader in other stations.
PCBA powered by external power supply in FCT1, FCT2, RF1 and Powered by battery in FCT3 & RF2.

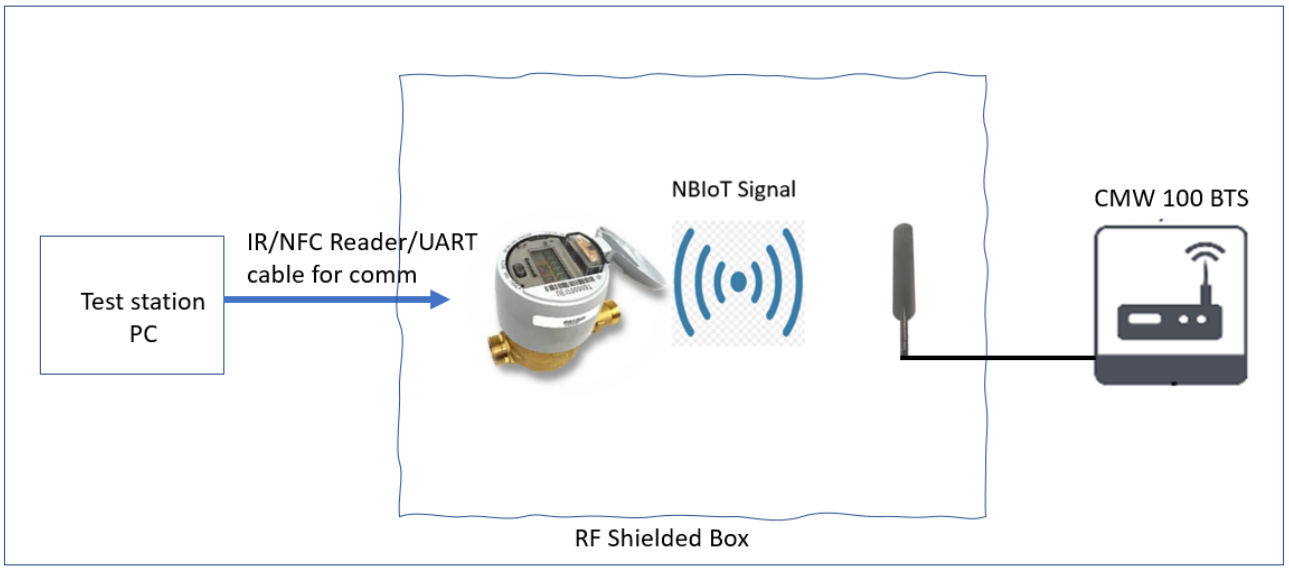
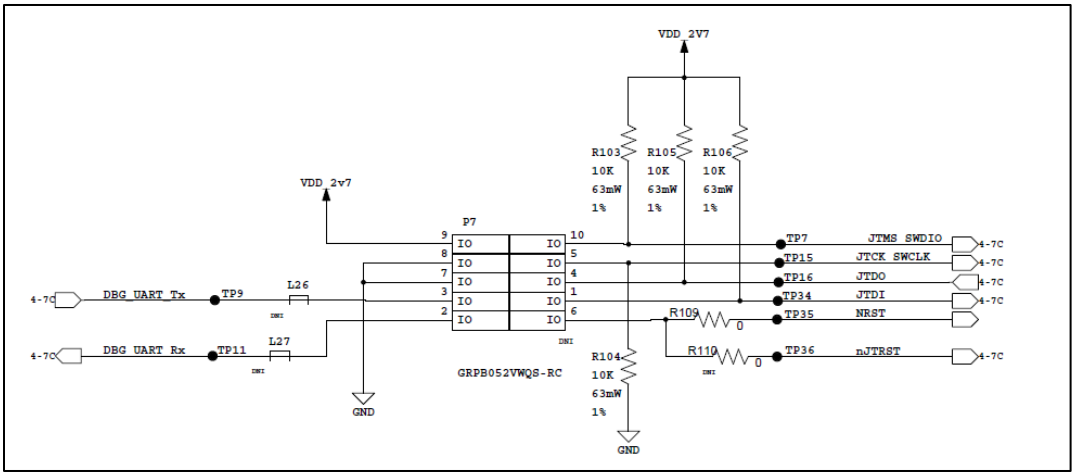


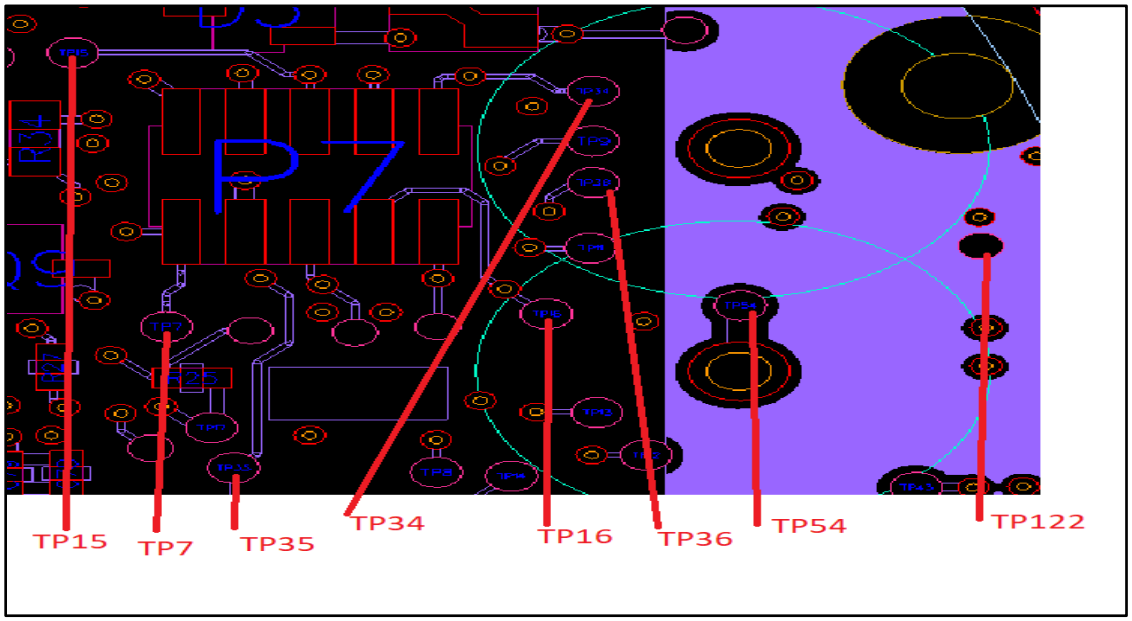
Figure 1: RF Testing Test Bench

2.2.2 Flash Programmer for STM32L443VCT6



Note: P3 connector will not be mounted on board, Test points to be used for accessing JTAG interface for programming the MCU

S.NO	Signal Name	Test point
1.	JTMS_SWDIO	TP7
2.	JTCK_SWCLK	TP15
3.	JTDO	TP16
4.	JTDI	TP34
5.	NRST	TP35
6.	nJTRST	TP36
5.	GND	TP54 or TP122



2.2.3 NFC link to PC

NFC is used to communicate with the MCU of DUT by sending commands.

Any NFC reader (preferable model DeskID-ISO RFID Desktop-Reader from Metratec) and an application shall be used to communicate with DUT.

For more information refer to the NFC Protocol Specifications documents

2.2.4 UART link to PC

Isolated UART is used to communicate with the MCU of DUT by sending UART commands. The level voltage of Isolated UART lines must be same as the voltage of the DUT (2.7V).

UART Test points:
TP5: SP_OP_TX
TP6: SP_OP_RX

UART settings:
speed: 9600bps
parity: none
stop bit: 1
HW/SW control: none

2.2.5 IR Interface

IR interface also can be used to communicate with the MCU of DUT by sending commands.

Optical interface according to IEC 62056-21 shall be used to communicate with DUT.

IR Reader settings:

speed: 9600bps
parity: none
stop bit: 1
HW/SW control: none

3. Test Firmware & Equipment

3.1 Firmware features

DUT has NFC, IR, and UART interfaces for communication.

3.1.1 TIMEOUTS

Each command send to the DUT expects a response from the DUT typically within 2s unless otherwise mentioned. While a timeout is generally not expected in case a timeout where to occur for any command, the command which timed out is to be resent and considered as ‘failed to execute’ only if the response times out again.

3.2 Measurement equipment

3.2.1 Frequency meter/Counter

The frequency meter will measure the 512Hz clock output at MCU GPIO pin generated from 32.768KHz Crystal frequency. Ensure shielded cable used between DUT to Frequency counter and cable length should be as short as possible from DUT to Frequency counter.

example: HM8123

3.2.2 Radio Communication Tester

Radio Communication Tester will be used to verify the Network Connectivity functionality of the device in non-signaling mode

Example: CMW100 from R&S (A Basic variant can be bought for Production tests). Ensure proper ventilation provided for CMW100 to avoid heating of the CMW100.

3.2.3 Current & Voltage meter

The Current Meter will measure the module consumption with 0. 1µA precision. Voltage meter can be a general 6 ½ digit Multimeter.

3.2.4 MCU Programmer

MCU Programmer will be used to load/flash the program on the Microcontroller.
Example: JTAG/SWIO Programmer J-Link ULTRA+

3.2.5 NFC Reader

NFC reader will be used to communicate with the MCU.
Example: DeskID-ISO RFID Desktop-Reader from Metratec

3.2.6 Optical IR Reader

Any optical IR reader comply to IEC 62056-21 shall be used to communicate with DUT.

3.2.7 DC Power supply

Variable multiple output DC power supply to be used. Preferable rating of 0-32VDC, 2A.

3.2.8 Camera for LCD Inspection

A suitable camera for LCD inspection to be used.

4. Test Sequence

This chapter describes hardware verifications that need to be done on the PCBA.

Note: Yellow highlighted parts in the document show that they are still work in progress and will be updated periodically when we have more clarity.

Below is the list of all Test Points from V200H board. ICT or FCT points to be added.

Test Points	Test Point Name	Test Points	Test Point Name
TP197	NB1_RESET	TP54	$18N14
TP169	$4N9537	TP187	LCD_VLCD
TP99	VDD_ALISA	TP44	NFC_VCC
TP171	$6N8661	TP160	$21N5
TP132	$2N18005	TP61	LCD_SEG01
TP75	LCD_SEG15	TP34	JTDI
TP97	$2N17104	TP39	NB1_RST_N
TP65	LCD_SEG05	TP107	$18N3593
TP112	NBIoT_PWR	TP24	VDD_EXT
TP55	NFC_ANTENNA1	TP51	VBAT_3V6
TP45	ALISA_CCW	TP14	TP_GPIO3
TP87	$18N1381	TP106	$2N18047
TP170	$6N8659	TP156	$4N7726
TP79	LCD_SEG19	TP154	$4N7721
TP10	$2N18095	TP29	NB1_SIMRST
TP191	I/O	TP185	NFC_ANTENNA
TP189	$4N7717	TP152	$2N19844
TP35	NRST	TP93	$2N16044
TP77	LCD_SEG17	TP83	LCD_SEG23
TP25	RXD_DBG	TP41	P3V6
TP91	$21N4	TP149	ALISA_CCW_F
TP15	JTCK_SWCLK	TP19	$4N7725
TP67	LCD_SEG07	TP151	$2N18263
TP166	$2N18215	TP105	$2N17780
TP69	LCD_SEG09	TP73	LCD_SEG13
TP165	$2N18157	TP130	FLASH_SCK
TP109	VBAT_CHECK	TP184	NFC_ANTENNA1
TP164	$21N16	TP63	LCD_SEG03
TP81	LCD_SEG21	TP53	NB1_RST_N
TP111	MCU_RX_NB1_TX	TP31	NB1_SIMDATA
TP163	$21N12	TP43	DVDD

TP129	I2C3_SYS_SCL	TP104	$2N17650
TP57	LCD_COM4	TP148	ALISA_CW_F
TP162	$21N11	TP9	DBG_UART_Tx
TP131	$2N17963	TP183	$21N27
TP47	ALISA_TEST	TP150	$21N28
TP94	$20N21	TP33	VDD_HALL
TP59	LCD_COM2	TP303	FM_PO_OUTPUT1
TP196	FM_NFC_PWR_CTRL	TP115	IRQ_NFC_FD
TP190	$15N5139	TP23	VBAT_3V6
TP84	$18N4264	TP13	TP_GPIO2
TP161	$21N6	TP11	DBG_UART_Rx
TP37	NB1_PSM_EINT	TP124	AVDD
TP159	$20N17	TP8	RTC_OUT
TP74	LCD_SEG14	TP103	$2N17608
TP71	LCD_SEG11	TP147	ALISA_PWR_CTRL
TP17	FLASH_VDD	TP146	ALISA_TEST_IO
TP64	LCD_SEG04	TP182	$21N24
TP49	NB1_RXD_IN	TP145	$18N1384
TP108	VBAT_VOLT	TP92	$2N11447

Test Points	Test Point Name	Test Points	Test Point Name
TP127	MCU_RI	TP56	NFC_ANTENNA
TP82	LCD_SEG22	TP80	LCD_SEG20
TP302	FM_PO_OUTPUT0	TP46	ALISA_STN
TP72	LCD_SEG12	TP58	LCD_COM3
TP7	JTMS_SWDIO	TP114	I2C3_SYS_SDA
TP202	GND	TP178	$18N3246
TP62	LCD_SEG02	TP121	GND
TP42	VDD_2V7	TP180	$18N4036
TP123	$2N17214	TP4	IDETECT
TP96	$2N16858	TP70	LCD_SEG10
TP140	HALL_PULSE	TP48	ALISA_WD_EN_F
TP102	$2N17566	TP36	nJTRST
TP32	NB1_SIMCLK	TP300	$18N4303
TP86	$18N1383	TP198	MFC_LINK
PWR	HALL	TP3	VDD_2V7
TP181	$21N20	TP26	TXD_DBG
TP22	ALISA_CW	TP60	LCD_COM1
TP179	$18N3594	TP193	RST
TP12	TP_GPIO1	TP200	$18N2264
TP98	$20N16	TP16	JTDO

TP137	$2N18101	TP100	$2N17125
TP122	GND	TP38	NB1_BOOT_N
TP76	LCD_SEG16	TP50	NB1_TXD_OUT
TP136	$2N18097	TP2	$18N681
TP88	$21N10	TP18	$4N7724
TP6	SP_OP_RX	TP120	GND
TP301	$18N4307	TP176	$18N1393
TP199	NB1_RI	TP118	ALISA_WD_EN
TP135	RESET-00	TP1	VBATT
TP78	LCD_SEG18	TP175	$16N764
TP66	LCD_SEG06	TP30	NB1_SIMVDD
TP201	$18N2265	TP174	$15N7646
TP90	$21N9	TP172	$15N5066
TP5	SP_OP_TX	TP192	CLK
TP125	$18N2269	TP95	$2N16813
TP68	LCD_SEG08	TP85	$18N1394
BT1.1	$18N4724		

4.1 Hardware verifications -ICT

This stage of the test process is used to verify any shorts, opens of nets and other basic quantities which may flag discrepancies and ensures that it is safe to fit the Li/SOCI2 3.6V batteries. All power supply nets are tested with no batteries fitted. The jumper link W1 and W2 is NOT soldered for this test stage.

Scan the 2D bar code label on the PCBA to start the production ICT test sequence.

The date [DD-MMM-YYYY] and time [HH:MM: SS] is recorded and logged against each bar code label that is scanned. Repeated tests on the same PCBA must be logged. All logged results must be sent to the Honeywell for every PCBA and every product that is delivered to Honeywell.

Log confirmation that Li/SOCI2 3.6V batteries are NOT FITTED to V200H PCBA.
And jumper link W1 and W2 is NOT soldered.

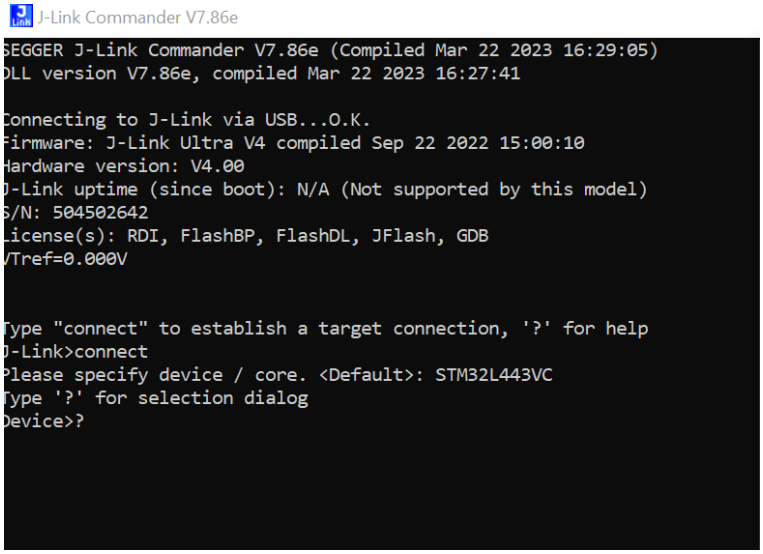
4.2 Hardware Verifications – FCT1

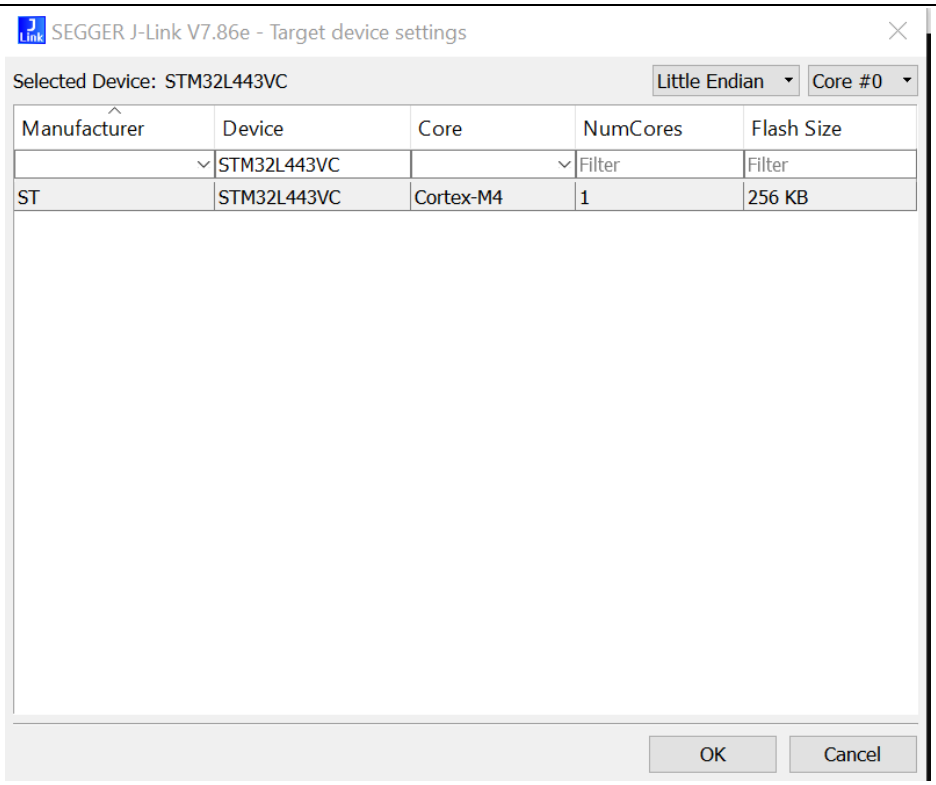
To start with production FCT test sequence scan the 2D barcode label on V200H PCBA. If the PCBA just scanned has not passed all previous tests, then this test sequence must be immediately aborted.

The date [DD-MMM-YYYY] and time [HH: MM: SS] is recorded and logged as the start time against each bar code label that is scanned. Repeated test sequences on the same PCBA must be logged with a new date and time for each. All logged results must be sent to Honeywell for every V200HPCBA delivered to Honeywell.

4.2.1 Loading of Firmware

Firmware loading detailed test process will be shared as a separate document < V200H Firmware Document >. Refer below steps for basic loading of Firmware through J-Link commander.

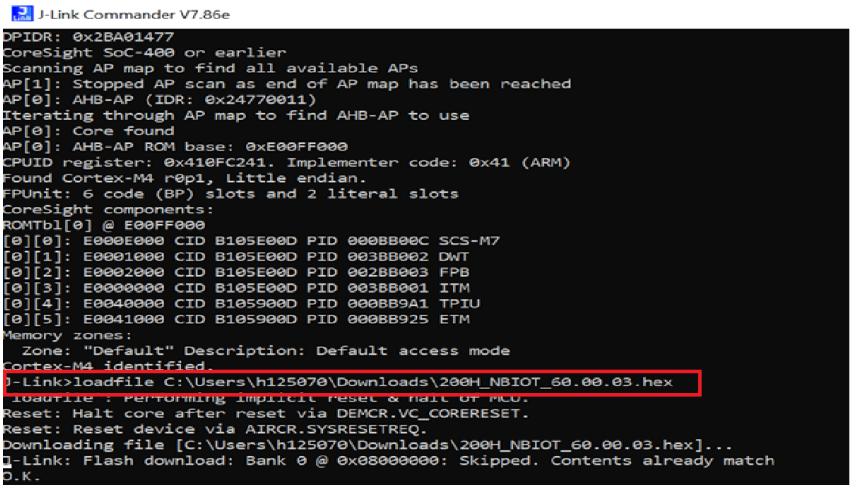
Step Title	**MCU Firmware programming**	**Priority:** High	**ID: FCT1_01**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	• Install and open J-Link commander Programming Software • Enter ‘connect’ in the terminal screen. Verify that correct device is selected.  • If the device is not correct, then press ‘?’ and select the correct device from popup window list.		

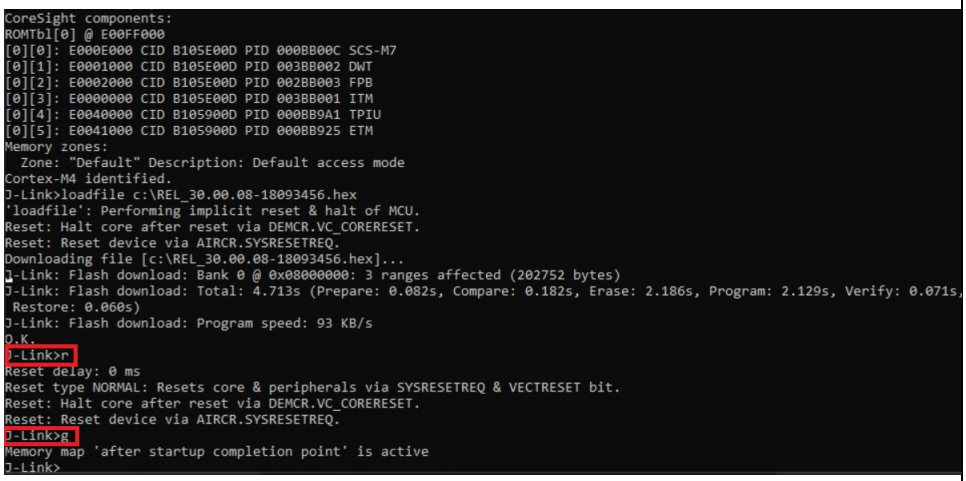


After selection of correct device “STM32L443VC”, press ok.

Load firmware file by ‘loadfile <file name>’ command.

Note: <file name> will be a format REL_60.ab.cd-xxxxxxxx.hex, exact file name to be referred to the V200H Firmware document.



	After successful loading of Firmware, select ‘r’ command to reset the device followed by execution of ‘g’ command to start the firmware execution.  When the device is up and running it will be in Factory state. • Once the Firmware loaded successfully send command <0xA6>[02] to read the firmware version and checksum value.
Test Purpose	To program the ST MCU.
Test Equipment	JTAG/SWIO Programmer J-Link ULTRA+
Pass/Fail Condition	Program loaded to MCU successfully and Firmware version and checksum value matching with respective Firmware loaded. The checksum value can be referred from Firmware documents.
Indications / Comments	No visual Indication for PASS/FAIL.
Possible Failure Codes	Not possible

4.2.2 Voltage Rails Check

<table>
<tr><td>Step Title</td><td>Voltage Rails measurement</td><td>Priority:
Medium</td><td>ID: FCT1_02</td></tr>
<tr><td>Model</td><td colspan="3">V200H NB-IoT Enabled Water Meter</td></tr>
<tr><td>Test Procedure</td><td colspan="3">Connect external power supply across TP41 (P3V6) and TP54(GND). Measure the voltage on board at VDD_2V7 (TP3), FLASH_VDD (TP17), VDD_ALISA (TP99), VBAT_3V6 (TP51), VDD_HALL (TP33), NB1_SIMVDD (TP30), AVDD (TP124), DVDD (TP43), P3V6 (TP41), VDD_EXT(TP24)</td></tr>
<tr><td>Test Purpose</td><td colspan="3">Measuring the voltages for accuracy, the variation in supply voltages will impact the RF measurements (Output power) & other functionalities.</td></tr>
<tr><td>Test Equipment</td><td colspan="3">6 1/2 DMM</td></tr>
<tr><td>Pass/Fail Condition</td><td colspan="3">
<table>
<tr><td rowspan="12">Input voltage @3.6V±0.05V</td><td></td></tr>
<tr><td>VDD_2V7: 2.7V±3%</td></tr>
<tr><td>FLASH_VDD: 2.7V±3%</td></tr>
<tr><td>P3V6: 3.6V ±3%</td></tr>
<tr><td>VDD_ALISA: 3.6V ±3%</td></tr>
<tr><td>VBAT_3V6: 3.6V ±3%</td></tr>
<tr><td>*VDD_HALL:2.7±3%</td></tr>
<tr><td>NB1_SIMVDD:1.8±3%</td></tr>
<tr><td>AVDD: 2.7±3%</td></tr>
<tr><td>DVDD: 2.7±3%</td></tr>
<tr><td>VDD_EXT:1.8±3%</td></tr>
<tr><td></td></tr>
</table>
* VDD_HALL voltage measurement is specific to the product variant. It’ll not be available in the base variant.
</td></tr>
<tr><td>Indications / Comments</td><td colspan="3">No visual Indication for PASS/FAIL.</td></tr>
<tr><td>Possible Failure Codes</td><td colspan="3">Not possible</td></tr>
</table>

4.2.3 Standby Current Consumption Measurement

Step Title	**Standby Current Consumption Measurement**	**Priority:** High	**ID: FCT1_03**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	1. Connect external power supply to DUT. 2. Wait for 30 sec for device to enter sleep mode and then measure the average current for 30 secs to observe the device standby current. 3. Measure standby current using Amp meter. 4. Ensure other than power supply all other interfaces must be disconnected from PCBA. * Standby current should be within 16 to 20.5 µA to meet 15 yrs. battery life.		
Test Purpose	Measuring the standby current, as higher standby current will reduce the battery life.		
Test Equipment	6 ½ Amp Meter		
Pass/Fail Condition	Pass: 16 to 20.5 µA Fail: Avg current >20.5 µA		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.2.4 Write PCB Serial Number

To track PCB's, write PCB serial number into the device using below supported command.

Step Title	**Write PCB Serial Number**	**Priority:** Medium	**ID: FCT1_04**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	• Send the command **<0xE4><data>** to write PCB serial number into the device. • **<data>** consists of 2 to 16 bytes which includes numbers and alphabets. • Send the command **<0x68>** to read PCB serial number from the device.		
Test Purpose	To write PCB Serial number		
Test Equipment	NA		
Pass/Fail Condition	Test is passed if reading PCB serial number should match with the serial number written into the device.		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.2.5 RTC Clock Accuracy Measurement

Step Title	**Measure Y1 frequency**	**Priority:** High	**ID: FCT1_05**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	RTC clock accuracy measurement to be done over 32sec and mean data to be used for PPM calculations. In order to Enable Clock output 1. Send command <0x86> in factory Mode 2. Wait for Ack or Timeout 3. RTC Clock available at TP8 Test Point: TP8 — Description: 512.0000000Hz Test Point: TP54 — Description: GND 4. After measurement derive the calibration factor from the 32sec mean data. Refer Calibration factor document for calculation. 5. To set the calibration factor to MCU, send command <0x06>. 6. Store the calculated calibration factor and to be set in FCT3 again. 7. After setting the calibration factor, re-verify the RTC clock measurement for 32 sec and mean data to be used for PPM calculations. Note: Crystal Frequency must be measured on a buffered output, directly probing at the crystal will load the crystal and drift the frequency. Continue other tests and at the end remove line power to stop the accuracy test **Note 1: A shielded cable from Test point to frequency counter input must be used for clock measurement to isolate the environmental noise interface.** **Note 2: Power supply to the tester to be filtered out by using ferrite and filter component between Power supply and tester** **Note 3: Keep the limit +/-20PPM until RTC error variation root cause identified, the limit will get change +/-2PPM after fixing the issue.**		
Test Purpose	Measure Clock output at MCU GPIO.		
Test Equipment	6 1/2 Digit Frequency Counter		
Pass/Fail Condition	512Hz+/-2ppm(Refer Note 3)		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.2.6 Built-In Self- Test

Step Title	**Built-In Self-Test**	**Priority:** Medium	**ID: FCT1_06**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	Built-In self-test (BIST) is used to test the peripherals such as external Flash and NFC EEPROM. External Flash: It verifies the Flash memory, SPI communication between flash and microcontroller and power switch. NFC EEPROM: It verifies the communication between NFC EEPROM and MCU via I2C Interface. 1. Send the Built-In self-test (BIST) command <0x2B> through UART interfaces 2. Wait for 10 seconds 3. Send a command <0x2C> to read the status of each peripheral as mentioned above. 4. Read the response, it's a 2 bytes response, 1st byte represents status of the NFC EEPROM and 2nd byte represent status of external Flash		
Test Purpose	To verify the functionality of NFC EEPROM and external Flash		
Test Equipment	Nil		
Pass/Fail Condition	If the status byte value is 0x0101 it means NFC EEPROM and external Flash tests are passed, otherwise, consider as failed. Byte 0 – If the value is 01, NFC EEPROM test is Passed, otherwise fail Byte 1 – If the value is 01, External Flash test is Passed, otherwise fail		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.2.7 Modem Interface & eSIM test

Step Title	**Modem Interface**	**Priority:** High	**ID: FCT1_07**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	• To test the internal interface between Modem and MCU, Modem information can be read out by giving various commands. • Send CMD: <0xCD> to read the SIM IMEI number, ICC ID of eSIM, IMSI number, Modem type and Modem FW revision number. Convert response parameters from HEX to ASCII to check the FW revision number with expected version number **< BC660KGLAAR01A05_01.002.01.002 >.** If version number not matching, then perform Modem FW upgrade. Steps refer V200H Modem Firmware document. • The Modem IMEI number and eSIM's ICC ID, IMSI should be linked and saved in the database for printing on the Label and also future purposes.		
Test Purpose	To verify the Modem Interface and FW Version correctness.		
Test Equipment	NA		
Pass/Fail Condition	PASS if below responses are read. Modem IMEI: 15-digit response. Modem FW Version: **BC660KGLAAR01A05_01.002.01.002** eSIM ICC ID: Unique number of each device eSIM IMSI no: Unique number of each device		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.2.8 Hall Sensor Test (Optional)

Step Title	**Hall Sensor Test**	**Priority:** High	**ID: FCT1_08**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	Test the Magnetic Tamper Hall Sensor by verifying that the Magnetic Tamper alarm has been triggered. • Set magnet to home position. • Send a command <0x2D> to read and verify magnetic tamper alarm is currently not in triggered state. • After minimum 20 seconds, move the magnet to the test position, after few seconds send a command <0x2D> to verity Magnetic Alarm is Set. • As soon as magnetic alarm is triggered, move the magnet back to the home position and after 20 second, send a command <0x2D> to verity Magnetic Alarm is Cleared. Hall Sensor test to start in parallel to Built-in self-test and modem interface test i.e., clauses **4.2.5, 4.2.6, 4.2.7** Note1: *HALL sensor test is specific to the product variant. It'll not be available in the base variant.* Note2: *Disable the command in the present script.*		
Test Purpose	To verify hall sensor functionality.		
Test Equipment	Nil		
Pass/Fail Condition	Response from DUT should indicate that the test passed successfully.		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.2.9 Manual Assembly and Soldering

Refer LUATA3041 for details.

4.3 Hardware Verifications-FCT2 + RF1

To start with production FCT 2 + RF1 test sequence scan the 2D barcode label on V200H PCBA. If the PCBA just scanned has not passed all previous tests, then this test sequence must be immediately aborted.

The date [DD-MMM-YYYY] and time [HH: MM: SS] is recorded and logged as the start time against each bar code label that is scanned. Repeated test sequences on the same PCBA must be logged with a new date and time for each. All logged results must be sent to Honeywell for every V200H PCBA delivered to Honeywell.

4.3.1 LCD Test

Step Title	**LCD Test**	**Priority:** Medium	**ID: FCT2+RF1_01**
Model	V200HNB-IoT enabled water meter		
Test Procedure	Connect external power supply 3.6V DC, 500mA across TP41 (P3V6) and TP54(GND). • Camera should be able to take the LCD picture at every second for a period 60 seconds, in these 60 frames, 2 frames complete LCD segments ON, 2 pictures complete segments off. • Send command <0x3F> [00 00 55 55 55 55 55 50] for enabling 55555555555 on display to check to identify leakage between LCD segments. • Send command <0x3F> [00 00 00 00 00 00 00 00] to enable 00000000000 on display. • Log all the LCD test sequence result. • Verify the LCD protective cover has been removed. A blue strike can be seen if the LCD protective cover is still fitted. Log that the LCD cover check has been done.		
Test Purpose	To verify LCD segments are displaying properly and there are no stuck LCD segments		
Test Equipment	Camera for LCD Inspection		

Pass/Fail Condition	All the segments should match as per the predefined LCD segment image
Indications / Comments	Visual Indication for PASS/FAIL.
Possible Failure Codes	Not possible

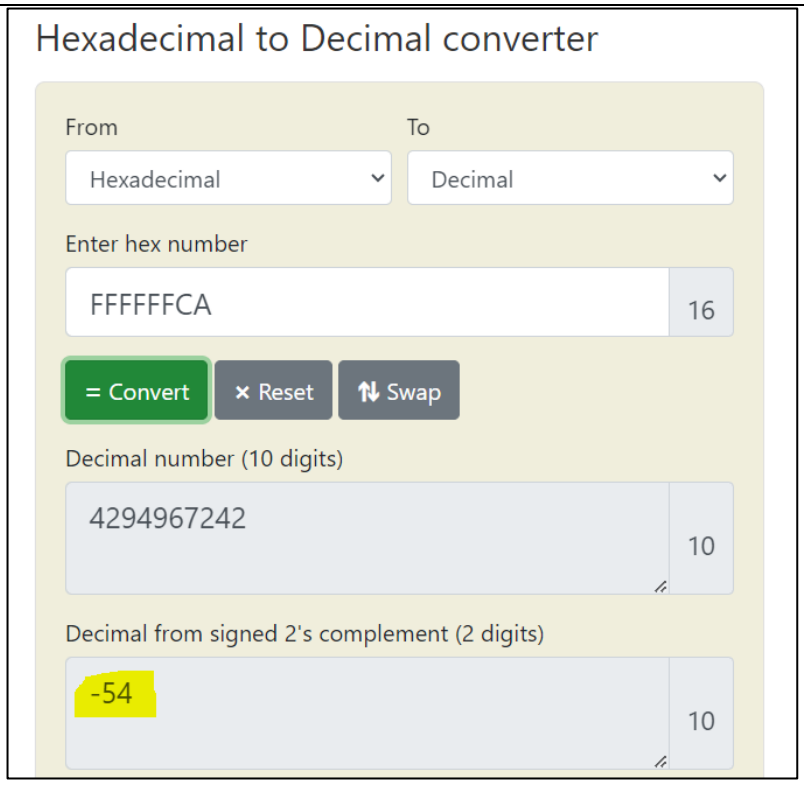
4.3.2 Modem Functionality – RF1 (Before Potting)

Modem radiated RF power measurement for 2 frequency bands

Step Title	**Modem Functionality**	**Priority:** High	**ID: FCT2+RF1_02**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	• Supply the board with 3.6V DC, ± 500mA current limit set at VBATT connector point. **Band 8:** • To test the Modem Functionality in Non-Signaling mode with CMW100. • Configure CMW100 to receive on Band 8 NB-IoT. Use uplink mid channel frequency 897.5MHz. • Send below commands in sequence over UART Interface to enable non-Signaling mode. For all the mentioned below commands need to send 0x43 before all the commands. 490343014154AB0D (AT) To read response send: 49014302BF0D 490D430141542B5153434C4B203D2030C50D (AT+QSCLK=0) To read response send: 49014302BF0D 490B430141542B4350534D533D32D90D (AT+CPSMS=2) To read response send: 49014302BF0D 490A430141542B4346554E3D309A0D (AT+CFUN=0) send 2 times based on response To read response send: 49014302BF0D		

	4910430141542451435246 4E53543D30303531EA0D (AT$QCRFNST=0051) To read response send: 49014302BF0D 4928430141542451435246 4E53543D3030353330383030304632333543303030313030303030303030303030D80D (AT$QCRFNST=005308000F235C00010000000000) To read response send: 49014302BF0D • Wait for 5 seconds and measure the RF power for 50 samples (max hold mode) at CMW100 and at the same time to measure average current. 4910430141542451435246 4E53543D30303534EF0D (AT$QCRFNST=0054) To read response send: 49014302BF0D 4910430141542451435246 4E53543D30303532E90D (AT$QCRFNST=0052) send 2 times based on response To read response send: 49014302BF0D • Send CMD: (AT+CFUN=1) to terminate the transmission. 490A430141542B4346554E3D319B0D (AT+CFUN=1) To read response send: 49014302BF0D **RSSI Measurement:** 1. Configure CMW100 to send ARB Multitone 20MHz waveform on Band 8 NB-IoT (942.5MHz; Channel: 3625). Set to -77dBm. 490343014154AB0D (AT) To read response send: 49014302BF0D

	Note: Immediately Send the below command within 5-6 Seconds to avoid modem to enter Deep Sleep Mode. 490D430141542B5153434C4B203D2030C50D (AT+QSCLK=0) To read response send: 49014302BF0D 490B430141542B4350534D533D32D90D (AT+CPSMS=2) To read response send: 49014302BF0D 490A430141542B4346554E3D309A0D (AT+CFUN=0) send 2 times based on response To read response send: 49014302BF0D 491043014154245143524 64E53543D30303531EA0D (AT$QCRFNST=0051) To read response send: 49014302BF0D 492443014154245143524 64E53543D3030353532393045303030303043303030303030343030D30D (AT$QCRFNST=0055290E00000C0000000400) To read response send: 49014302BF0D 491043014154245143524 64E53543D30303536ED0D (AT$QCRFNST=0056) To read response send: 49014302BF0D Copy the response and convert from HEX to ASCII. Response example: 'MT000140017000000CAFFFFFF6000000000000000020000000'. If any other type of response comes, Test is FAIL. Convert the Green highlighted part in the response from HEX to DEC. This will give the RSRP value. Reference given below.



49104301415424514352464E53543D30303532E90D
(AT$QCRFNST=0052) send 2 times based on response

To read response send: 49014302BF0D

- Send CMD: (AT+CFUN=1) to terminate the transmission.
  430141542B4346554E3D31 (AT+CFUN=1)

  To read response send: 49014302BF0D

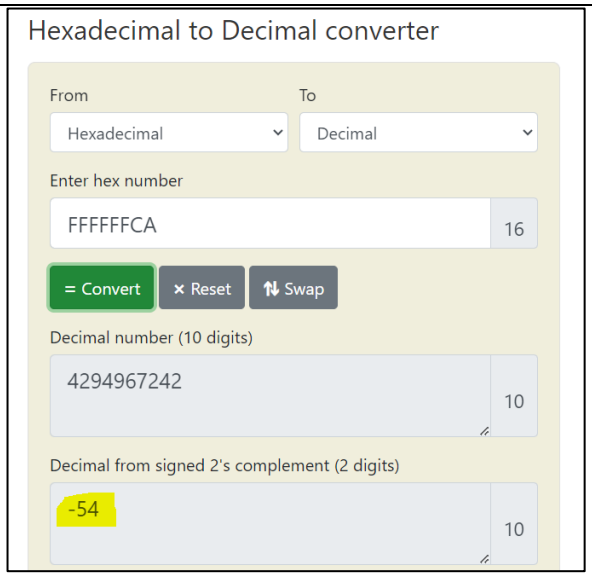
Band 3:

RSSI Measurement:
1. Configure CMW100 to send ARB Multitone 20MHz waveform on Band 3 NB-IoT (1842.5MHz; Channel: 1575). Set to -77dBm.

490343014154AB0D (AT)

To read response send: 49014302BF0D

	Note: Immediately Send the below command within 5-6 Seconds to avoid modem to enter Deep Sleep Mode. 490D430141542B5153434C4B203D2030C50D (AT+QSCLK=0) To read response send: 49014302BF0D 490B430141542B4350534D533D32D90D (AT+CPSMS=2) To read response send: 49014302BF0D 490A430141542B4346554E3D309A0D (AT+CFUN=0) send 2 times based on response To read response send: 49014302BF0D 491043014154245143524 64E53543D30303531EA0D (AT$QCRFNST=0051) To read response send: 49014302BF0D 492443014154245143524 64E53543D303035353237303630303030304330303030303030343030AE0D (AT$QCRFNST=0055270600000C0000000400) send 2 times. To read response send: 49014302BF0D 491043014154245143524 64E53543D30303536ED0D (AT$QCRFNST=0056) To read response send: 49014302BF0D Copy the response and convert from HEX to ASCII. Response example: 'MT00001400170000000CAFFFFFF6000000000000000020000000'. If any other type of response comes, Test is FAIL. Convert the Green highlighted part in the response from HEX to DEC. This will give the RSRP value. Reference given below.



49104301415424514352464E53543D30303532E90D (AT$QCRFNST=0052) send 2 times based on response

To read response send: 49014302BF0D

- Send CMD: (AT+CFUN=1) to terminate the transmission. 430141542B4346554E3D31 (AT+CFUN=1)

  To read response send: 49014302BF0D

Band 3 Power Measurement:

- To test the Modem Functionality in Non-Signaling mode with CMW100.
- Configure CMW100 to receive on Band 3 NB-IoT. Use uplink frequency 1747.5MHz.
- Send below commands in sequence over UART Interface to enable non-Signaling mode. For all the mentioned below commands need to send 0x43 before all the commands.

  490343014154AB0D (AT)

  To read response send: 49014302BF0D

  490D430141542B5153434C4B203D2030C50D (AT+QSCLK=0)

  To read response send: 49014302BF0D

  490B430141542B4350534D533D32D90D (AT+CPSMS=2)

  To read response send: 49014302BF0D

	490A430141542B4346554E3D309A0D (AT+CFUN=0) send 2 times based on response To read response send: 49014302BF0D 4910430141542451435246 4E53543D30303531EA0D (AT$QCRFNST=0051) To read response send: 49014302BF0D 4928430141542451435246 4E53543D3030353330333030343334343543303030313030303030303030303030A30D (AT$QCRFNST=0053030043445C00010000000000) To read response send: 49014302BF0D • Wait for 5 seconds and measure the RF power for 50 samples (max hold mode) at CMW100 and at the same time to measure average current. 4910430141542451435246 4E53543D30303534EF0D (AT$QCRFNST=0054) To read response send: 49014302BF0D 4910430141542451435246 4E53543D30303532E90D (AT$QCRFNST=0052) send 2 times based on response To read response send: 49014302BF0D • Send CMD: (AT+CFUN=1) to terminate the transmission. 490A430141542B4346554E3D319B0D (AT+CFUN=1) To read response send: 49014302BF0D
Test Purpose	To verify the Modem RF Functionality in Radiated Non-Signaling mode.
Test Equipment	(CMW100), TG.30.8113 (Part No- 931-1213-ND)
Pass/Fail Condition	PASS if readings are within below limits: Band 8: RF Output power: 6 dBm ≤ Power ≤ 11 dBm RSSI level: -60dBm/15kHz ≤ RSSI ≤ -40dBm/15kHz

	Band 3: RF Output power: -3 dBm ≤ Power ≤ 2 dBm RSSI level: -65dBm/15kHz ≤ RSSI ≤ -45dBm/15kHz Measured current should be within 50 to 80mA Note 1: All the RF power measurement ranges defined without any correction factor in CMW100. Note 2: Current ranges will be redefined based on more board data, presently follow as per the defined limit.
Indications / Comments	No visual Indication for PASS/FAIL.
Possible Failure Codes	Not possible

4.3.3 Battery Voltage Measurement

Step Title	**Battery voltage Measurement**	**Priority:** High	**ID: FCT2+RF1_03**
Model	V200H Digital water meter		
Test Procedure	Check Battery: • Measure battery voltage between TP54 (GND) and TP1 with additional 1.8kΩ resistive load connected between TP54 (GND) and TP1 during voltage measurement. • Connect 1.8kΩ resistive load then wait 1 second then measure battery voltage then disconnect resistive load immediately. Measured battery voltage should be between 3.635V and 3.700V • Log the VBATT LOAD battery voltage with 1.8kΩ load connected. Remove 1.8kΩ resistive load then verify measured voltage is higher than previous measurement to verify load has been disconnected. Measured battery voltage should be between 3.640V and 3.700V. • Log the P3V6 OPEN without 1.8kΩ load connected.		
Test Purpose	To verify battery health and it is safe to assemble on PCBA		
Test Equipment	Nil		
Pass/Fail Condition	Response from DUT should indicate that the test passed successfully.		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.3.4 Pulse Output Test(Optional)

Step Title	**Pulse output Test**	**Priority:** High	**ID: FCT2+RF1_04**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	The Wired Pulse Output has four different control modes (Disable, Bi-directional, Separate or Reverse Compensated). The Wired Pulse Output configuration is tested in [control mode=Separate] where a single pulse is produced on each output. 1. Connect 1kΩ 1% pull-up resistor between (PO_OUTPUT0_R) [TP300 / J1-1 / Brown] and the positive terminal of an external power supply set to 3.6VDC. 2. Connect 1kΩ 1% pull-up resistor between (PO_OUTPUT1_R) [TP301 / J1-2 / White] and the positive terminal of an external power supply set to 3.6VDC. 3. The negative terminal of the external power supply must be referenced to (GND_PO) [J1-3 / Green]. 4. Use UART command [0xA7] to set the Wired Pulse Output configuration [Pulse width=10mSec, Control=Separate, Pulse weighting = 1/1000] 5. Use UART command [0x27] to read the Wired Pulse Output configuration. 6. Send [BB3F] command to set pulse output for output 0 & output 1. 7. For Output 0, verify the transition from high to low (3.6V to 0V) on TP300 and for output 1, verify the transition from high to low (3.6V to 0V) on TP301 after executing the above command. 8. Send [BB40] command to reset pulse output GPIOs for output 0 and 1. Note: *Pulse output test is specific to the product variant. It'll not be available in the base variant.*		
Test Purpose	To Verify the pulse output		
Test Equipment	6 1/2 Digit Frequency Counter		
Pass/Fail Condition	Output 0 and output 1 pulse, there should be a transition from High to Low.		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.3.5 ALISA Count check (Before potting)

ALISA Measuring constant check

Step Title	ALISA Rotation Constant check	Priority: High	ID: FCT2+RF1_05
Model	V200H NB-IoT enabled Water Meter		
Test Procedure	Power the board and check if P3 of Alisa is on low state (PIN NO. 16 of U12) NOTE: After powering the board, wait for 10 sec to boot the system.		
Test Purpose	Verifies the setting of Alisa measuring constant (1impulse/rotation) stage when the board is power supplied.		
Test Equipment	6 1/2 DMM		
Pass/Fail Condition	The Voltage at P3 pin of ALISA PIN NO.16 of U12, ICT150 must be 0V (±5%).		
Indications / Comments	No visual Indication for PASS/FAIL. Use 6 1/2 DMM.		
Possible Failure Codes	Not possible		

4.3.6 Counting CW check

Step Title	ALISA Forward Rotation check	Priority: High	ID: FCT2+RF1_06
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	Measurement of “direct flow” by checking the “Positive Impulses” reported by the DUT against rotation number produced by the mechanical fixture to determine if the deviation is within the specification. 1. Send Command <0x2E> to read current Index 2. Wait for response, which gives current Index of the meter. 3. Before starting the actual rotation, 2 rotations are required in CW directions to initialize the ALISA chip. 4. Start rotation of the target in forward (CW) direction, stop it after 100 number of rotations. 5. Send Command <0x2E> to read current Index 6. The new index given by the response – index given by old response should be within 300 ± 3 rotations.		
Test Purpose	Verifies the accuracy of Alisa Rotation Count in Forward direction when the board is power supplied.		
Test Equipment	Motor simulator fixture is required		

Pass/Fail Condition	If (index difference > 303) or (index difference < 297) then, Fail; Else it is Pass;
Indications / Comments	No visual Indication for PASS/FAIL.
Possible Failure Codes	Not possible

4.3.7 Counting CCW check

Step Title	**ALISA Reverse Rotation check**	**Priority:** High	**ID: FCT2+RF1_07**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	Measurement of “Reverse flow” by checking the “Negative Impulses” reported by the DUT against rotation number produced by the mechanical fixture to determine if the deviation is within the specification. 1. Send Command <0x2F> to get current index value 2. Wait for response, which gives current Index of the meter. 3. Start rotation of the target in reverse (CCW) direction, stop it after 100 number of rotations 4. Send Command <0x2F> to read current index value 5. The new index given by the response – index given by old response should be within 300 ± 3 rotations.		
Test Purpose	Verifies the accuracy of Alisa Rotation Count in reverse direction when the board is power supplied.		
Test Equipment	Motor simulator fixture is required		
Pass/Fail Condition	If (index difference > 303) or (index difference < 297) then, Fail; Else it is Pass;		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.3.8 Optical Interface Test

Step Title	**Optical Interface Test**	**Priority:** Medium	**ID: FCT2+RF1_08**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	• Test the optical communication by aligning the optical probe on the register assembly. • Send the command <0x25> to read RTC time • Log the test data		
Test Purpose	To verify the functionality of optical interface post potting		
Test Equipment			
Pass/Fail Condition	Test is passed if device is responded with RTC value, otherwise its fail.		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.3.9 Sleep Current Consumption Measurement – Register

Step Title	**Sleep Current Consumption Measurement- Register**	**Priority:** High	**ID: FCT2+RF1_09**
Model	V200H NB-IoT enabled water meter		
Test Procedure	Before measuring the sleep current 1. Wait for 30 sec for device to enter sleep mode and then measure the average current for 30 secs to observe the device sleep current. 2. Measure Sleep current using Amp meter. 3. Ensure other than Battery power supply, all other interfaces must be disconnected from PCBA. * Sleep current should be within 16 to 22 µA to meet 15 yrs battery life.		
Test Purpose	Measuring the sleep current. Higher sleep current will reduce the battery life.		
Test Equipment	6 ½ Amp Meter		
Pass/Fail Condition	Pass: 16 to 22 µA Fail: Avg current > 22 µA		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

Multiple measurements and an average calculation is needed because of the pulse interface. To get a fair value of the Standby current, the programmer and the UART lines must be disconnected (or in High impedance) Pay attention to this measure, the current in about 16 to 22µA.

4.3.10 Enable JTAG Level-2 security

Step Title	**Enable JTAG Level-2 security**	**Priority:** High	**ID: FCT2+RF1_10**
Model	V200H NB-IoT enabled water meter		
Test Procedure	Send command <0xFE>[0x02] to enable J-Tag Level 2 security.		
Test Purpose	To enable J-Tag level 2 security.		

Test Equipment	NA
Pass/Fail Condition	0x00 Response from DUT should indicate that the test passed successfully.
Indications / Comments	No visual Indication for PASS/FAIL.
Possible Failure Codes	Not possible

4.3.11 Manual soldering

The sequence of Jumper shorting to be followed strictly.

First, connect the W2 Jumper and then connect the W1 Jumper and product reset in jig.

4.3.12 Battery Voltage Check

Step Title	**Battery Voltage check– Register**	**Priority:** Medium	**ID: FCT2+RF1_11**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	Measure battery voltage between TP1 (VBATT) and TP54 (GND) or on W1 solder bridge. The 1.8kΩ resistive load should NOT be fitted for this test. Measured battery voltage should be minimum 3.62V and maximum 3.68V. Log the battery voltage.		
Test Purpose	To verify the battery health with register load		
Test Equipment	6 1/2 DMM		
Pass/Fail Condition	Measured Battery voltage should be within 3.62V and 3.68V		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.3.13 Modem Firmware Upgrade (Optional step)

Step Title	**Modem Firmware upgrade**	**Priority:** High	**ID: FCT2+RF1_12**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	This step is applicable only when Modem FW version is older than **< BC660KGLAAR01A05_01.002.01.002>** version and required a mandatory FW upgrade.		

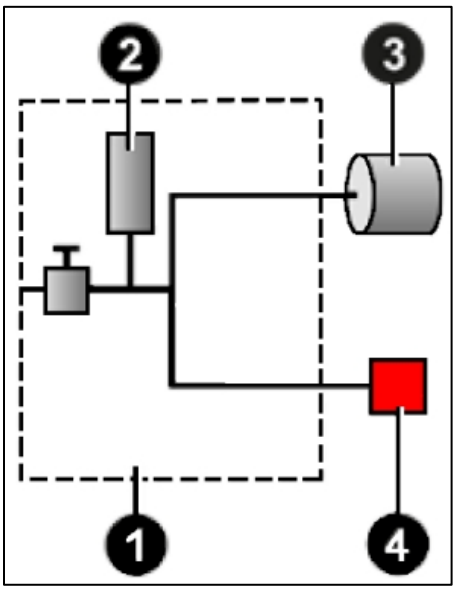
	Time being, if modem version is not matching, discard the board. Refer the V200H Modem Firmware document for the upgrade.
Test Purpose	To verify the FW Version correctness and if not to upgrade with correct version
Test Equipment	NA
Pass/Fail Condition	PASS if read correct FW version
Indications / Comments	No visual Indication for PASS/FAIL.
Possible Failure Codes	Not possible

4.4 Leak Detection Test

After the top cover is sealed, perform a Leak detection test using ATEQ F620 tester.

Desensitized test:

This mode is used for detection of leaks. The test pressure is applied to the input of the part under test 3. The measurement is performed by the pressure sensor 2.



Refer LUATA4173 for details.
For Leak test 1, the measured pressure should be within 65Pa.
For Leak test 2, the measured pressure should be within 10 Pa.

For Potting and curing related instruction Refer LUATA3041.

4.5 Hardware Verifications – RF2+FCT3

The RF2+FCT3 test is now required for the V200H hardware when powered from internal battery power and inserted into a plastic register cup.

To start with production RF2+FCT3 test sequence scan the QR code label on the V200H register.

If the V200H register serial number just scanned have not passed all previous ICT tests and FCT tests, then the FCT3 test sequence must be immediately aborted.

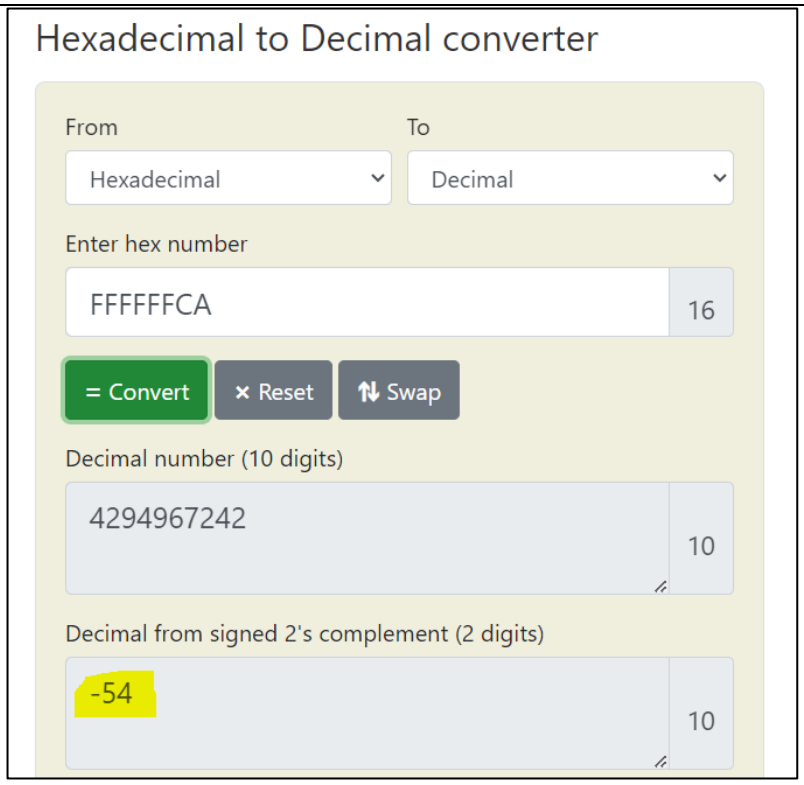
The date [DD-MMM-YYYY] and time [HH: MM: SS] is recorded and logged as the start time against each bar code label that is scanned. Repeated test sequences on the same PCBA must be logged with a new date and time for each. All logged results must be sent to Honeywell for every V200H PCBA delivered to Honeywell.

4.5.1 Modem Functionality – RF2 (After potting)

Step Title	**Call Connection & SIM Interface**	**Priority:** High	**ID: RF2+FCT3_01**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	• To test the Modem Functionality in Non-Signaling mode with CMW100. **Band 8:** • Configure CMW100 to receive on Band 8 NB-IoT. Use uplink frequency 897.5MHz. • Send below commands in sequence over NFC Interface to enable non-Signaling mode: 43014154 (AT) To read response send: 4302 430141542B5153434C4B203D2030 (AT+QSCLK=0) To read response send: 4302 430141542B4350534D533D32 (AT+CPSMS=2) To read response send: 4302 430141542B4346554E3D30 (AT+CFUN=0) send 2 times based on response To read response send: 4302 43014154245143524 64E53543D30303531 (AT$QCRFNST=0051)		

	To read response send: 4302 4301415424514352464E53543D303035333038303034632333543303030313030303030303030303030 (AT$QCRFNST=005308000F235C00010000000000) To read response send: 4302 • Wait for 5 seconds and measure the RF power for 50 samples (max hold mode) at CMW100 and at the same time to measure average current. 4301415424514352464E53543D30303534 (AT$QCRFNST=0054) To read response send: 4302 4301415424514352464E53543D30303532 (AT$QCRFNST=0052) send 2 times based on response To read response send: 4302 • Send CMD: (AT+CFUN=1) to terminate the transmission. 430141542B4346554E3D31 (AT+CFUN=1) To read response send: 4302 **RSSI Measurement:** 1. Configure CMW100 to send ARB Multitone 20MHz waveform on Band 8 NB-IoT (942.5MHz; Channel: 3625). Set to -77dBm. 43014154 (AT) To read response send: 4302 Note: Immediately Send the below command within 5-6 Seconds to avoid modem to enter Deep Sleep Mode. 430141542B5153434C4B203D2030 (AT+QSCLK=0) To read response send: 4302 430141542B4350534D533D32 (AT+CPSMS=2) To read response send: 4302

	430141542B4346554E3D30 (AT+CFUN=0) send 2 times based on response To read response send: 4302 4301415424514352464E53543D30303531 (AT$QCRFNST=0051) To read response send: 4302 4301415424514352464E53543D3030353532393045303030303043303030303030343030 (AT$QCRFNST=0055290E00000C0000000400) send 2 times. To read response send: 4302 4301415424514352464E53543D30303536 (AT$QCRFNST=0056) To read response send: 4302 Copy the response and convert from HEX to ASCII. Response example: 'MT00001400170000000CAFFFFFF6000000000000000020000000'. If any other type of response comes, Test is FAIL. Convert the Green highlighted part in the response from HEX to DEC. This will give the RSRP value. Reference given below.



430141542451435246 4E53543D30303532 (AT$QCRFNST=0052)
send 2 times based on response

To read response send: 4302

- Send CMD: (AT+CFUN=1) to terminate the transmission.
  430141542B4346554E3D31 (AT+CFUN=1)

  To read response send: 4302

- Send CMD: 4300 to disable the modem power.

Test Purpose	To verify the Modem functionality and check all the RF parameters are within the specified limits.
Test Equipment	BTS/Radio Communication Tester, RF shielded box
Pass/Fail Condition	PASS if readings are within below limits: Band 8: RF Output power:5 dBm ≤ Power ≤ 8 dBm RSSI level: -65 dBm/15kHz ≤ RSSI ≤ -45 dBm/15kHz

	Note 1: All the RF power measurement ranges defined without any correction factor in CMW100.
Indications / Comments	No visual Indication for PASS/FAIL
Possible Failure Codes	Not possible

4.5.2 LCD Test

Step Title	**LCD Test**	**Priority:** Medium	**ID: RF2+FCT3_02**
Model	V200H NB-IoT enabled water meter		
Test Procedure	• Camera should be able to take the LCD picture at every second for a period 60 seconds, in these 60 frames, 2 frames complete LCD segments ON, 2 pictures complete segments off. • Send command <0x3F> [00 00 55 55 55 55 55 50] for enabling 55555555555 on display to check to identify leakage between LCD segments. • Send command <0x3F> [00 00 00 00 00 00 00 00] to enable 00000000000 on display. • Log all the LCD test sequence result.		
Test Purpose	To verify LCD segments are displaying properly and there are no stuck LCD segments		
Test Equipment	Camera for LCD Inspection		
Pass/Fail Condition	All the segments should match as per the predefined LCD segment image		
Indications / Comments	Visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.5.3 Reset Battery Parameters

Step Title	**Reset Battery Parameters**	**Priority:** High	**ID: RF2+FCT3_03**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	Send command <0xC6>[02 00] for reset battery parameters.		
Test Purpose	To reset Battery parameters.		
Test Equipment	NA		
Pass/Fail Condition	C600 Response from DUT should indicate that the test passed successfully.		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.5.4 Set RTC Calibration Factor

Step Title	**Set RTC Calibration Factor**	**Priority:** High	**ID: RF2+FCT3_04**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	Send command <0x06> for setting the RTC calibration Factor.		
Test Purpose	To re-write RTC calibration constant.		
Test Equipment	NA		
Pass/Fail Condition	0600 Response from DUT should indicate that the test passed successfully.		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.5.5 Optical Interface Test

Step Title	**Optical Interface Test**	**Priority:** Medium	**ID: RF2+FCT3_05**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	• Test the optical communication by aligning the optical probe on the register assembly. • Send the command <0x25> to read RTC time • Log the test data		
Test Purpose	To verify the functionality of optical interface post potting		
Test Equipment	Optical probe		
Pass/Fail Condition	Test is passed if device is responded with RTC value, otherwise its fail.		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.5.6 Counting CW check

Step Title	**ALISA Forward Rotation check with Gear Plate assembly**	**Priority:** High	**ID: RF2+FCT3_06**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	Measurement of “direct flow” by checking the “Positive Impulses” reported by the DUT against rotation number produced by the mechanical fixture to determine if the deviation is within the specification. 1. Send Command <0x2E> to read current Index 2. Wait for response, which gives current Index of the meter. 3. Before starting the actual rotation, 2 rotations are required in CW directions to initialize the ALISA chip. 4. Start rotation of the target in forward (CW) direction, stop it after 100 number of rotations. 5. Send Command <0x2E> to read current Index 6. The new index given by the response – index given by old response should be within 300 ± 3 rotations.		
Test Purpose	Verifies the accuracy of Alisa Rotation Count in Forward direction when the board is power supplied.		
Test Equipment	Motor simulator fixture is required		

Pass/Fail Condition	If (index difference > 303) or (index difference < 297) then, Fail; Else it is Pass;
Indications / Comments	No visual Indication for PASS/FAIL.
Possible Failure Codes	Not possible

4.5.7 Counting CCW check

Step Title	**ALISA Reverse Rotation check with Gear Plate assembly**	**Priority:** High	**ID: RF2+FCT3_07**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	Measurement of “Reverse flow” by checking the “Negative Impulses” reported by the DUT against rotation number produced by the mechanical fixture to determine if the deviation is within the specification. 1. Send Command <0x2F> to get current index value 2. Wait for response, which gives current Index of the meter. 3. Start rotation of the target in reverse (CCW) direction, stop it after 100 number of rotations 4. Send Command <0x2F> to read current index value 5. The new index given by the response – index given by old response should be within 300 ± 3 rotations.		
Test Purpose	Verifies the accuracy of Alisa Rotation Count in reverse direction when the board is power supplied.		
Test Equipment	Motor simulator fixture is required		
Pass/Fail Condition	If (index difference > 303) or (index difference < 297) then, Fail; Else it is Pass;		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.5.8 Internal Temperature Sensor Test

Step Title	**Internal Temperature sensor test**	**Priority:** High	**ID: RF2+FCT3_08**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	1. Use Optical Probe to send command <0x8A> to read V200H MCU ambient temperature. 2. Verify reported V200H MCU temperature is to be Predefined Specification of between 22 deg C to 32 deg C. 3. Log reported V200H MCU ambient temperature value in degrees C.		
Test Purpose	To verify the functionality of internal temperature sensor		
Test Equipment	Nil		
Pass/Fail Condition	Log the measured temperature.		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.5.9 Remaining Battery life

After completion of RF End of line test, measure Remaining battery life.
Remaining battery life in days value should be >= 5470 days.

Step Title	**Remaining Battery Life**	**Priority:** Medium	**ID: RF2+FCT3_09**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	• Send the command <0xF0> to read the remaining Battery life. • This command returns Remaining Days, Battery Alarm.		
Test Purpose	To verify the Remaining battery life		
Test Equipment	NA		
Pass/Fail Condition	Test is passed if remaining battery life in days is >= 5470 days.		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

4.5.10 Write Register ID

After accomplishing all the tests, Write Register ID into the device

Step Title	**Write Register ID**	**Priority:** Medium	**ID: RF2+FCT3_10**
Model	V200H NB-IoT Enabled Water Meter		
Test Procedure	• Send the command <0xB5> to write Register ID into the device. • After successful writing, Send the command <0x35> to read back the register ID from the device and compare with the written value.		
Test Purpose	Writing Register ID		
Test Equipment	NA		
Pass/Fail Condition	Test is passed if both the values are matches.		
Indications / Comments	No visual Indication for PASS/FAIL.		
Possible Failure Codes	Not possible		

Example:

Register ID: 0DV1242600010

Register ID	1	2	3	4	5	6	7	8	9	10
0DV1242600010	0	0	30	44	56	12	42	60	00	10

Byte 1 & Byte 2: Reserved, filled with 0's
Byte 3, Byte 4 & Byte 5: Written in ASCII format (0DV -> 334456)
Byte 6 to Byte 10: Written in BCD Format (1242600010 -> 1242600010)

5. SLEEP MODE

After completion of all the tests, finally put the device in Sleep mode by using Below NFC Command.

1. Modem always in PSM Mode, except sending RF data transfer.
2. Issue a Command <0xD0> to Change the Device state to Sleep Mode
3. Send a command <0xD1> to read the device state.

6. Label

6.1 V200H PCBA product label

Each V200H PCBA will have a 2D label fitted to a designated location on each PCB. This label will be used to track the PCBA through the entire manufacturing and test process. Refer below image.

Traceability label (QR code content)

HWI@@BWXXYYZZZZZ

HWI-FG number
@@-Hardware Version
BW- BOM Version
XX- Year
YY- week code
ZZZZZ- Running serial number (Week wise)
Sample Physical Label content (HWI010B235000001)
Sample Content to be written in PCB (HWI010B235000001)

6.2 V200H Gear Plate label

Each V200H Gear plate will have a 2D label fitted. This label will be marked at the backside. Refer below image.

6.3 Register Product label

Each V200H register will have a 1D product label fitted to the front face of the register cup as shown in the picture below. PCBA Info can be used as the register serial number and to be mapped in the system for traceability. Refer Register label drawing <3014-2533-001>.

Appendix 1: Current Measurement

Method 1:

Method 1 uses a custom hardware setup to measure the average current draw from our range of battery powered products is described below.

1) Run a reference calibration on the current measurement device before running production test operations.
2) Current measurement device performs at least 1024 measurement samples per second.
3) Connect shunt resistor [10Ω - for measuring µA range] in series with external power supply.
4) Measure current for 10 seconds.
5) Take average value of each 1024 block of samples per second.
6) Take average value of the 10 average values calculated above over each second.
7) This is the value delivered as the result for the average current measurement.

Method 2:

Method 2 uses a Keysight 34465A to measure the average current draw.

1) A reference calibration is run using a precision resistor which is fitted to a V200H PCBA.
2) The reference calibration is used to verify that the Keysight 34465A is delivering current measurement results that are within the EMS test station limits and V200H test limits.
3) For V200H current measurements the Keysight 34465A is set to 0.006PLC/100usec measurement time.
4) Keysight 34465A is set to collect 50,000 samples per measurement.
5) Keysight 34465A delivers average value of 50,000 measurements.

Appendix 2: LCD Segment Test

Camera should be able to take the LCD picture at every second for a period 60 seconds, in these 60 frames, 2 frames complete LCD segments ON, 2 pictures complete segments off and other frames with all 0's. Refer below images of LCD segments ON and OFF.

Figure 1: LCD Segments ON

Figure 2: LCD Segments OFF

This completes the LCD segment test sequence.