Firmware Release Note

Equipment: RWC5020A/B/M, RWC5021P

Revision History

Version	Date	Description
V1.606	25/Nov/2026	**[LoRaWAN]** 1. **[Pre-Certification]** 2. During certification testing, the DownlinkDwell value must stay at its default of 0, but in some test items it was set to 1 and never restored before the test ended, which affected subsequent certification items. Fixed so that this value is always kept at 0. **[RF Performance]** 3. **[NST]** 4. **[Link Analyzer]** 5. Added a ChInfo parameter to the AIoT JoinAccept so that users can modify it. **[ETC]** 6.
V1.605	12/Nov/2026	**[LoRaWAN]** 1. **[Pre-Certification]** 2. **[RF Performance]**

		3. **[NST]** 4. **[Link Analyzer]** 5. Previously, sending a MAC command in EDT mode transmitted it only once. Added a MAC_SEND_MODE parameter so that setting it to CONTINUOUS sends the MAC command repeatedly. **[ETC]** 6. Added a feature that retrieves time information from an NTP server. An NTP_SERVER parameter was added to the SETUP screen to enable or disable this feature, and when NTP_SERVER is set to ON, the NTP_IP_ADDR and NTP_UTC parameters are displayed.
V1.604	21/Oct/2026	**[LoRaWAN]** 1. **[Pre-Certification]** 2. Fixed an issue in EU868 certification where Invalid DR was transmitted as 14 instead of the required value of 15. 3. Fixed a bug where the failure reason was displayed as "None" when a timeout occurred due to AGC lock failure during certification. 4. Fixed a bug where, in certification test 2.5.8.b.ii.1.1 – 125 kHz Uplink Channel Management – Valid Command Processing, the DR in LinkADRReq was sent as 0 instead of 15. **[RF Performance]** 5. **[NST]** 6.

		[Link Analyzer] 7. **[ETC]** 8.
V1.603	06/Aug/2026	**[LoRaWAN]** 1. **[Pre-Certification]** 2. Fixed a verification error in US915/AU915 certification test 2.5.8.d.i. (DR Decay test for all devices) in 8-ch mode, where the RWC5020x checked only 16 UL packets instead of 128 when determining full 8-channel usage after the DUT enabled all channels. **[RF Performance]** 3. **[NST]** 4. **[Link Analyzer]** 5. **[ETC]** 6. Added AIoT as an operator for the KR920 region.
V1.602	16/July/2026	**[LoRaWAN]** 1. **[Pre-Certification]** 2. **[RF Performance]** 3.

		[NST] 4. **[Link Analyzer]** 6. The RESP_TO range for MAC commands has been extended from 6,000 seconds to 172,800 seconds (48 hours). This change was intended to be applied in Ver 1.510 but was inadvertently omitted and has now been re-applied. 7. Added a variable to determine whether to compare the Join Nonce value against the previous value or ignore it and proceed when a Join Accept is received in GWT mode. **[ETC]** 8. Added AIoT as an operator for the KR920 region.
V1.601	16/Jun/2026	**[LoRaWAN]** 1. **[Pre-Certification]** 2. **[RF Performance]** 3. **[NST]** 4. **[Link Analyzer]** 5. In the FUOTA test, setting packet loss to a value other than 0 was designed to randomly select and skip transmission of fragment packets. Based on customer feedback, this has been modified so that the first packet is always transmitted. **[ETC]** 6.

V1.600	02/April/2026	**[LoRaWAN]** 7. Regional Parameters RP002-1.0.5 specification has been applied. The main update in this specification is the addition of DR for SF5 and SF6. **[Pre-Certification]** 8. Added certification test items for DUTs classified as END-DEVICE, as defined in the Relay Mechanism Test Specification. **[RF Performance]** 9. Added system clock offset vs. PER function to RX Sensitivity. The system clock offset is adjusted in ppm units. This function tests how much clock offset the device can tolerate by varying the system clock of packets transmitted from the RWC5020X and measuring the reception limit. This function is available only for RWC5020B/M **[NST]** 10. **[Link Analyzer]** 11. Added End-device under Relay test mode to EDT. When RELAY_MODE is set to ON, the RWC5020X emulates the complete system including Network Server, Gateway, and Relay. In this mode, the RWC5020x receives WOR messages sent by the DUT and responds with WOR ACK as needed, providing an environment that simulates DUT communication with a Relay. 12. When calculating the MIC for the FragSessionSetupReq used in FUOTA, we originally included the message padding. Due to a customer request, we modified the firmware in V1.513 to exclude the padding from the MIC calculation. However, we believe this change was incorrect. We have therefore reverted the modification to once again include the padding in the MIC

		calculation. **[ETC]** 13.
V1.5200	15/Oct/2025	**[LoRaWAN]** 1. **[Pre-Certification]** 2. The dwell time value of RWC5020x has been improved to be set to the default value (ON) when starting AS923 and AS915 Certification. 3. There was a bug where the MaxEIRP value was transmitted as 8dBm regardless of the region's default value when sending the TXParamSetupReq command. This value was improved to be set to the region's default value. 4. There was a bug in the Au915 test case "5.11.a RX1 Receive Window Test", where instead of sending UL_DR=2, RX1DROffset=1 for DR9, it sent UL_DR=2, RX1DROffset=2. It has been fixed. 5. Fixed an error where some failed log messages were not displayed. 6. There was a bug in the calculation of aggregated TX times in the 'Retransmission Backoff Tests'. It has been fixed. 7. A bug has been corrected in the RWC5020x related to the LORA_CERTI_ALL_05_08_D_II Additional DR Decay test. Since the IN868 region does not support DR6, the expected behaviour is a decay from DR7 directly to DR5. The tester was incorrectly flagging this normal DR change as a failure, but this has now been resolved. 8. Corrected an error in the LORA_CERTI_ALL_05_08_D_I DR Decay test, where a failure due to multiple missed UL packets was incorrectly displaying the reason as the ADRACKReq bit being cleared. We have now improved the display of the failure reason.

		[RF Performance] 9. Fixed a bug where GWT's NRT would not run if there was no NST option. **[NST]** 10. SF5, SF6 modulation added to NST SG/SA/MFG. 11. Fixed an issue on the 64ch model where the frequency measurement would occasionally return 0 when operating in NST mode. 12. Separated the CR and CRC variables for the implicit header mode in NST. **[Link Analyzer]** 13. In the FUOTA test, there was a bug where the Mc Interval was not applied, so it was improved. 14. There was a bug in the MIC calculation in FragSessionSetupReq. It has been fixed. 15. The RX_Delay range of the RxTimingSetupReq command has been changed from 1~10 to 1~15. 16. The "No answer to MAC command" option was applied to only the MAC command. Now it has been extended to apply not only to the MAC command but also to the APP command. 17. Add NO_ANSWER_TO APP_COMMAND parameter in the abnormal test function. 18. Fixed bug where changing Multicast DR in FUOTA would only work with DR5. 19. In FUOTA, RWC502x waited until the multicast session ended after sending all fragments to the DUT before moving to the next step. To shorten the test time, it was improved to move to the next step immediately after sending all fragments, even if the multicast session was not finished. 20. Setting PACKET LOST in FUOTA should not cause packets to be sent randomly, but in reality, they were sent in order, and only the last few packets were not sent. This bug has been fixed to skip packets randomly.

		21. When packet loss is set in the FUOTA test, the time until the next transmitted packet is increased, while information is displayed on packets that are not transmitted. 22. Fixed the issue where DL packets were occasionally not transmitted properly in EDT mode of the 64-channel model. 23. The CR (Coding Rate) and CRC (Cyclic Redundancy Check) for LoRa packets were previously set using a single parameter. This caused an issue where the CR could not be configured when the CRC was disabled. To resolve this, the CR and CRC parameters have been separated to allow for independent configuration. 24. Fixed an issue in the GWT mode's Link Analyzer where the timestamp value for TX packets was not incrementing in the log messages. 25. The Link message information display has been enhanced regarding the RX delay (Del). The system was used to only display the RX1 delay value. We have now corrected this so that if the message is transmitted or received on the RX2 Channel, the displayed delay will be the RX1 delay plus one. **[ETC]** 26. The function to change non-default channel frequency values in 8-channel mode was removed in Ver1.510, but this function has been added again. 27. The receive channel decision algorithm has been enhanced by dropping packets with incorrect CRCs or those suspected of being incorrect. 28. Fixed an issue on the 64ch model where the screen would unexpectedly switch to the Touch Screen Calibration display during GWT mode operation. 29. The problem with the RWC5020M failing to control the RWC2020A properly has been fixed. 30. Added the verification of the DICount value while testing pre-certification.
V1.510	06/May/2024	**[LoRaWAN]**

		1. **[Pre-Certification]** 2. In AS923 Cert 15.11 CHANNEL MASK, the DR range of the NewChannelReq command was changed from 0-7 to 0-5. **[RF Performance]** 3. The 16-channel option has been added, and a MULTI_CH variable has been introduced for selecting either 8-CH or 16-CH mode in the EDT RF settings. **[NST]** **[Link Analyzer]** 4. The RESP_TO range for MAC commands has been extended from 6,000 seconds to 172,800 seconds (48 hours). 5. The probability of error occurrence was improved by improving the channel detection algorithm when receiving 64 channels. 6. Added class B mode for FUOTA test functionality. 7. A “redundancy level” parameter for FUOTA has been added to define how many redundancy packets to transmit. 8. A packet loss parameter for FUOTA has been added to define the number of fragment packets to skip for anomaly testing. **[ETC]** 9. Display model number while booting.
V1.500	03/JAN/2024	**[LoRaWAN]** 1. Change default values of channel tables in AS923-4 to suit regional requirements 2. Change default values of channel tables in RU864 to suit regional requirements **[Pre-Certification]** 3. Increase the timeout while waiting for JoinRequest 4. In Certi EU868 5.9.e.i.1, when the device retransmits

		RXParamSetAns, RX2 DR may change to an incorrect value, so this has been improved. 5. IN865 12.5 UL Ch Management UnSupport DR, if test option DR is not selected, maximum DR will change from 7 to 5. **[RF Performance]** 6. **The 64-channel option has been added**, and a MULTI_CH variable has been introduced for selecting either 8-CH or 64-CH mode in the EDT RF settings. **[NST]** **[Link Analyzer]** 7. Improved to detect the FUOTA protocol version of the DUT and operate accordingly. 8. When testing FUOTA, only AppTime was allowed, but this has been improved to allow time synchronization using the DevTime command. 9. In the FUOTA test, there is a possibility that the MC session timeout value is set to a large value, and in this case, there was a problem in which the test ended before the MC session ended. **[ETC]**
V1.400	12/AUG/2023	**[LoRaWAN]** 1. Improved to check the incorrect Join Request channel value for LoRaWAN V1.0.4 in CN470 and display an error message. 2. Fix bug in Join response channel value for LoRaWAN V1.0.4 on CN470. In the case of channel plans 26M_A and 26M_B, the Join response should have used the RX2 channel frequency but used the normal DL frequency. 3. AU915 Beacon packet structure was incorrect in LoRaWAN V1.0.4. It has been fixed. 4. The RWC5020x did not respond with an ACK DL packet when it received a Confirmed UL packet with no payload and port

		number 224. It has been fixed to respond with an ACK DL packet. 5. In GWT mode, DL MAC commands in Foptions field without payload were interpreted incorrectly so the tester did not send a response to it. It is fixed in this version. **[Pre-Certification]** **6. Add Class B Certification (Class B Certification Specification v1.0)** **7. Add Class C Certification (Class C Certification Specification v1.0.1)** **8. Upgrade LW1.0.4 Class A Certification for All Regions (v1.6)** 9. In All Cert 3.1.a and 5.7, the RX2 frequency in RxParamSetupReq was out of the allowed frequency. It is fixed to use the allowed frequency value except for the default. 10. n All Cert 1.1 Activation Pre-test, Checking the DevNonce value was missed. It is improved to check DevNonce as well. 11. In All Cert 5.2.b NewChannelReq, the frequency table of KR920 has been changed to comply with Korean regulations. 12. Optional DR channel for AS923 is changed to 5. 13. In All Cert 5.8.a TXPower, checking the RFU(14) Tx power index should have been skipped in US915. It is changed to skip the RFU checking in US915. 14. In All Cert 1.1 Oversized test case, added one more procedure to properly respond to RxParamSetAns. 15. In All Cert 1.4.a.i AES encryption, the maximum payload size could exceed the limit in some cases. It is fixed to be used less than the allowed payload size as per the DR. 16. Added NewChannelReq procedure on All Cert 5.11.d RX Oversized Payload to test optional DR. 17. Added NewChannelReq procedure on All Cert 5.11.e.i Max Payload via Echo to test optional DR. 18. Added NewChannelReq procedure on All Cert 5.11.e.ii Oversized Payload via Echo to test optional DR.

		19. The RX2 frequency needs to be restored to defaults before starting certification, but the setting of other applications such as link analyzers has been used in the certification. it is fixed to reset RX2 frequency when certification starts. 20. The Frequency offset of AS923 should have been applied to RX2 frequency in LinkADRReq. It is fixed to add frequency offset to the LInkADRReq. 21. In All Cert 14, Prioritizing Multiple MAC Commands, DownlinkDwellTime was set to 1 because it was not mentioned in the specification. It changes to 0. 22. In All Cert 14, Prioritizing Multiple MAC Commands, there was a verdict error when the DUT sends a LinkCheckReq on a separate uplink. 23. Added Wait DL_Count procedure after receiving LinkADRAnsq on EU Cert 5.9.c RX1 and RX2 Simultaneous Frame. 24. Changes the channel 4-7 frequency value of the RU864 region. it was out of the allowed frequency range and affected All Cert 5.2.b test results. 25. Min DR and MAX DR were set to the same value in All Cert 5.8.d.i, which may affect test results. Fixed to set Min DR to 0. **[RF Performance]** 26. The RX AGC boundary between Lower and Low for RWC5020B/M has been changed from 10 dBm to 15 dBm for proper operation of the frequency counter. 27. While setting Target DR, the payload size of PER test is always overwritten by 1. This bug was fixed to be set to a custom value. 28. EDT & GWT AGC On/Off parameters were separated from NST and modified to be independently controllable. **[NST]** 29. Added Implicit Header mode for NST TX and NST RX. **[Link Analyzer]**

		30. The first byte was changed to 0x03 without notice when user data was sent to the 224 port number. This bug has been fixed to send what the user has set. 31. It has been improved to display Join Request messages with error information when the DEV_EUI or APP_EUI do not match. 32. Added a malfunction test that disables responding to UL MAC commands, Confirmed Up or Join Requests. 33. Added RX gain to link analyzer packet info. 34. In the EDT FSK mode, when the DUT transmits UL quickly (less than 1 sec) after DL, RWC5020x missed this packet. It has been improved. **[ETC]** 35. The maximum payload size of the remote command "CONF:LINK:PAYLOAD" was limited to 127 bytes. It must be 242 bytes. This bug has been fixed. 36. Downgrade the FUOTA protocol version to V1.0.0 as most DUTs only support V1.0.0. 37. In the FUOTA test, if the DUT sent a DeviceTimeReq twice in a single frame with an AppTimeReq, the RWC5020x did not accept it. It is improved to accept this frame and handle the next step in the FUOTA testing. 38. Fix the bug of certification option
V1.330	12/Oct/2021	**[LoRaWAN]** 1. Regional parameters have been updated according to the RP-2-1.0.3 specification. - Add AS923-4 to support the Israel region. 2. Removed the temporarily added IL-917 regional parameter for Israel local testing. 3. Applied the latest application layer protocols for FUOTA testing. The list of application layer protocols is as follows. - TS003-Application_Layer_Clock_Synchronization_v2.0.0-rc4 - TS004-Fragmented_Data_Block_Transport_v2.0.0-rc7

		- TS005-Remote_Multicast_Setup_v2.0.0-rc3 - TS006-Firmware_Management_Protocol-v1.0.0-rc3 - TS007-Multi_Package_Access-v1.0.0-rc3 4. Removed the temporarily added KZ-865 regional parameter. 5. Fixed a bug in displaying more than 64 channels in the UL & DL channel list in the GUI in the case of GWT/ CN470/ LoRaWAN operation mode. **[Pre-Certification]** 6. Fixed a bug in the verdict algorithm for the "RX1 and RX2 simultaneous frames" certification (5.9.C) test for EU868 v1.6. 7. The packet for the downlink error test consisted of a random payload of port number 100. However, according to the test specification, it was changed to use 0x03 (unconfirmed command) and additional random bytes with port number 224. It has been modified to conform to the new specification. 8. In EU Cert 5.7, the Failure information message was not correct for not sending LinkChekReq. It is fixed to show correct information as “DUT didn’t send LinkCheckReq”. 9. Minimum and maximum power calculations were reversed for All Cert 5.8.a TX power. Fixed in this version **[RF Performance]** 10. RX GAIN RANGE information was incorrect for RWC5020A. It was adjusted to an appropriate value. 11. Added RX power monitoring and storage function. 12. Improved AGC function to not apply MIC error packets. 13. In EDT or GWT mode, the AGC function cannot detect the saturated input power. It is fixed to automatically change the RX gain by detecting the saturation condition. **[NST]** 14. In the FSK of NST TX, the data display was displayed with FSK and TX frequency values. It is changed to display the actual transmitted data value.

		15. The range of DATA_RATE for FSK in NST TX is changed from 1.0-128KBPS to 0.5KBPS-250KBPS. 16. Changed the "FM_DEVIATION" range for FSK in NST TX from 10-100KHz to 1-100KHz. 17. Improved NST test speed by reducing the delay of NST related remote commands. 18. In MFG mode, the tester may not receive packets because the SF of the MFG is not set correctly. It has been fixed. 19. Increased the number of digits of the measured frequency counter value in Hz **[Link Analyzer]** 20. MIC_ERR_DISPLAY parameter was missed in GWT mode. Added it to the LINK parameter screen in GWT mode. **[ETC]** 21. Added HW warranty information to the SYSTEM screen.
V1.320	30/Apr/2021	**[LoRaWAN]** 1. The protocol version parameter is separated from LoRaWAN1.0.3 to LoRaWAN1.0.2 and LoRaWAN1.0.3 to support different features for the two versions. 2. Added IL917 regional parameters for Israel. **[Pre-Certification]** 3. Added Pre-certification for All regions for LoRaWAN 1.0.4. **[RF Performance]** **4.** LoRaWAN 1.0.4 no longer supports test mode MAC command, so the RF performance scenario only supports normal mode for LoRaWAN 1.0.4. The Certi_Echo and Certi_DL_Count modes are removed. 5. The average number parameter of the frequency counter has been added.

		[NST] 6. RF AGC ON/OFF parameter has been added to the NST RX and MFG modes. **[Link Analyzer]** 7. Since LoRaWAN 1.0.4 no longer supports Test mode MAC commands, those MAC commands are removed from Link Analyzer's list of MAC commands. **[ETC]** 8.
V1.310	15/Feb/2021	**[LoRaWAN]** 1. The protocol version parameter is separated from LoRaWAN1.0.x to LoRaWAN1.0.3 and LoRaWAN1.0.4 to support different features for the two versions. 2. Fixed a bug where RWC5020x would die while responding when there were more than 4 MAC commands in a single frame. **[Pre-Certification]** 3. Upgrade EU Certification to V1.6 4. Upgrade US Certification to V1.5.1 5. Upgrade AS Certification to V1.1.1 6. Upgrade IN Certification to V1.1.1 7. Upgrade KR Certification to V1.2.1 8. In the TX Power test item of the LoRaWAN Pre-certification tests, the power measurement procedure has been improved so that power measurement is performed again when the power measurement is not normally performed due to the RX GAIN change by the RX AGC function. **[RF Performance]** 9. The INIT_RX_GAIN parameter was removed. Instead, the RX_GAIN parameter is automatically updated according to the RX signal power and stored in memory for the next link setup.

		10. Added “No RX packet notification” message. If there are no packets for a while (RX_GAIN_WARING_TO), it will prompt to check the tester's RX GAIN or DUT TX setting. 11. Fixed a bug where the power measurement value became incorrect when very high input power (over 10dBm) suddenly came into the RWC5020x due to an AGC operation error **12.** In KR920 SKT mode, the DR setting MAC command for PER measurement has been changed to be transmitted as Confirmed and FOpts. **[NST]** 13. In the MFG test, the RWC5020x was improved to ignore packets received when transmitting. 14. Fixed bug with last TX packet power setting in MFG test. The last TX packet power was incorrectly set as the end flag packet power. 15. In the MFG test, we corrected a sequence number display error. **[Link Analyzer]** 16. In EDT mode, it is improved to update the DL channel values while modifying the UL channel values. 17. The range of the TIME_OFFSET parameter was changed from +/-10,000us to +/-100,000us. **[ETC]** 18. Fixed a bug to send ACK response to the *SAVE, *RECALL remote commands 19. RWC5020M did not provide a save/recall function. However, the Save/Recall function is also enabled for the RWC5020M for quick setup of some configurations.
V1.300	17/Aug/2020	**[LoRaWAN] – adaptation to TS001-1.0.4 / RP002-1.0.1** 1. Add AS923_CH_CROUP and AS923_FREQ_OFFSET parameters to accommodate country specific sub-bands. 2. DR6 and DR7 are allowed for downlink of AS923.

		3. DR7 is allowed for downlink of IN865. 4. Add UL_DWELL_TIME parameter for AU915. 5. CN470 Regional Parameter has been significantly changed and is not backward compatible with the previous version. - Add CH_PLAN parameter to support channel plan 20M Type A, 20M Type B, 26M Type A, and 26M Type B - Most default RF frequency values are changed according to the new spec. 6. The version display was integrated into LoRaWAN1.0.x while reflecting the changes of LoRaWAN 1.0.4. 7. Fixed to maintain the current DR when receiving LinkAdrReq with DR15. **[Pre-Certification]** 8. After running the US915 Certi item 9.4, some DUTs that have the function to turn on all RF channels automatically, may cause a problem that the next test items do not proceed normally. To avoid this, it has been modified to send the LinkADRReq to set the proper channel mask at the end of the test item 9.4. 9. Updated IN865 Certification with Ver1.1 **[RF Performance]** 10. If the DUT does not respond properly to the sensitivity test, it will auto-stop after several attempts. **[NST]** 11. For long preamble testing, the maximum value of the preamble size of NST TX has been changed from 13 to 255. 12. The RX preamble size has been added to NST RX. **[Link Analyzer]** 13. Added MIC_ERROR, XOR_MHDR, XOR_FHDR parameters to generate abnormal MAC command for malfuction test. 14. Added time stamp function to log messages

		15. Added DEV_EUI on contents of Join Request message **[ETC]** 16. Added remote command for Reboot and Factory Reset. 17. Added remote command for IP setting. 18. Added protection function to reset in case of save/recall memory error. **1.**
V1.220	18/May/2020	**[LoRaWAN]** 1. The default value of the channel mask for AS923 in GWT was incorrectly set to 0x07 indicating 3 channels. Changed to 0x03 to indicate only 2 channels. **[Pre-Certification]** 2. In the SKT TC01, the DUT reset timing was not appropriate; the RWC5020x sent the reset command to the DUT even after receiving a Join-request message from DUT, causing the activation to fail sometimes. Removed unnecessary reset commands. 3. In 10.1 of US/CA915 Certification, the RX1DROffset value for DL DR setting was not correct. Fixed it. **[RF Performance]** 4. Changing TX power while the link is running caused the link to be stopped automatically. Changed to keep the link status even though TX power is changed. 5. In the RX sensitivity test in GWT mode, the RWC5020x counted up the number of errors even when missing a packet from the DUT. Fixed not to include the tester's fault into the test result. 6. Improved comment messages in the RX sensitivity test in GWT mode. 7. One of the scenarios for TX power measurement in EDT mode, CERTI_UL was renamed to CERTI_DL_CNT. 8. In the RX sensitivity test, a big difference between the normal

		link power (defined in the RF configuration) and the initial power for the RX sensitivity test could cause a DUT not to receive packets due to sudden big change of the power. Improved with a way of changing the power gradually so that the DUT can adapt. **[NST]** 9. There was a problem in receiving LoRa packets caused by incorrect setting of the RX polarity and the SF. Fixed it. 10. RX packet parameters were not allowed to modify while the Signal Analyzer (NST RX function) is running. Improved it possible. 11. Removed the DUT TYPE parameter from NST TX, NST RX and MFG to avoid complexity. 12. Removed the optional DR from the RX sensitivity test in GWT mode, because an End-device cannot initiate configuration of optional DR for the link. **[Link Analyzer]** 13. Increased the maximum limit of the MAC_ANS_TO from 600 to 6,000 seconds, to cope with a DUT whose UL interval is very long. 14. There was a system halt issue due to an initialization failure of the LoRa modulation chipset when the frequency band is changed from high (862~960MHz) to Low (400~510MHz). Fixed it. 15. In EDT mode, RWC5020x responded with Join-accept even for Join-request over an invalid channel. Fixed it by preventing RWC5020x from responding, and just marking the received join-request as a channel error. 16. Added Periodic Downlink option in Class A Mode – None, Confirmed, or Unconfirmed. 17. FPort was displayed as 000 for a packet with no payload. Changed it to be shown as “---“. 18. Even after receiving a Join-accept with the MIC error in GWT

		mode, the RWC5020x acted as activated by sending uplink messages. Fixed it. **[ETC]** 19. Improved the FW upgrade function with two-step method - the FW binary data is transferred to the main processor of the tester, and it is written into the flash memory for better reliability of upgrading. 20. In GWT mode, the downlink slot parameter had to be selected manually to RX1, RX2, or RX1&RX2 according to the test purpose. Improved the receiver performance of the RWC5020x, so that the downlink slot is fixed to RX1&RX2. Removed the downlink slot parameter. 21. Improved the calibration function of the touch screen.
V1.210	09/Jan/2020	**[LoRaWAN]** 1. In CN470, DR5 is decoded as DR0. Fix this bug. 2. In RU864, KZ865, the default value of Ping DR is changed as DR3. **[Pre-Certification]** 3. In SKT TC05, RWC5020x sent unconfirmed ExtDevMgmt message. Change the message type as confirmed. 4. Remove SKT TX Power test which uses index 7 because of specification is changed. 5. In SKT TC01, certification was not stopped properly. Fix the bug. 6. In SKT certification, DUT control method is improved for better synchronization with certification procedure. 7. In RWC5020x Ver1.20, the minimum power index of IN Certi 9.2 was mistakenly changed from 10 to 15. It is returned to 10. **[RF Performance]** 8. In Normal UL sensitivity test, RWC5020x sent Activate Test mode command. It is fixed to do not send Activate Test mode command in this mode.

		9. Fix the AGC problem in CW Power & Frequency Test measurement. **[NST]** 10. Network setting had problem. It did not applied to RF correctly. 11. Some parameters have been shared between TX/RX/MFG modes. Separate all parameters for independent set. **[Link Analyzer]** 12. IN865 ADR_CH_MASK range was limited to 0x07. The range of this value is changed as 0x7F. 13. Change the Maximum value of UPDATE_FCNT from 0xFFFF to 0xFFFFFFFF 14. Fix the bug of multiple LinkADRReq in GWT. RWC5020x only applied the last LinkADRReq command. Fix the bug with applying the channel masks in US915 and AU915. The changed channel mask value was not immediately applied.
V1.200	16/Sept/2019	1st Official Firmware Release for RWC5020B **[LoRaWAN]** 1. Add KZ865 regional parameters. 2. Fix the Bug. In EDT mode, the first of second group UL channel should be modifiable but it showed as unmodifiable. 3. Fix the Bug. After TX power measurement was executed, SET_TEST_MODE function did not work correctly. 4. Modify Class B test scenario to use default value of PING_PERIODICITY. This value becomes editable in EDT mode from this version 5. Increase Maximum number of UL channel from 7 to 8 for EU868 region in EDT mode 6. Increase Maximum number of UL channel from 6 to 7 for IN865 region in EDT mode 7. Add AS923CH_MODE parameter to select AS923 band(AS920-923, AS923-925) 8. Channel number was fixed for optional DR. From this version,

		the channel number for optional DR is editable. 9. Change Pop-up value list of ADR_DR for LINK_ADR MAC Command in EDT from [DR_0, DR_1, DR_2, DR_3, DR_4, DR_5, DR_6, DR_7] to [DR0_SF12BW125, DR1_SF11BW125, DR2_SF10BW125, DR3_SF9BW125, DR4_SF8BW125, DR5_SF7BW125, DR6_SF7BW250, DR7_FSK50]. 10. Allow to transmit DL packet in beacon guard time in class B mode **[Pre-Certification]** 11. Add option for US915 certification 2.1 and 2.2 to skip checking alternatively using BW125 and BW500 BW for Join request. 12. In India Certi 10.1 for RX Parameter setup testing, RX2 frequency value is changed from 867550000Hz to 866750000Hz. 13. In India Certi 15.2 for oversized payload testing, DLcounter value is ignored to check Pass/Fail verify. 14. In US Certi 3.1 for Channel Plan and usage, RWC5020A/B waited up to 40 packets to check channel usage. But Certi spec requires wait just 2 times of channel number then number of waiting packets is reduced to 16. It becomes tighter. 15. In US Certi 12.2 for Uplink-oversized payloads via Echo, RWC5020A/B checked Downlink Counter value for verdict. From this version, RWC5020A/B does not use Downlink Counter value for verdict because the Certi spec is not clear. 16. In US Certi 9.2 TxPower, user can select power index range from this version. Old spec uses from 0 to 10 index range, but new spec uses from 0 to 14 index range. 17. In US Certi 9.2 TxPower, RWC5020A/B did not measure TX power to check power difference between max index and min index. It was the bug and fixed in this version. **[RF Performance]** 18. Target Channel Mask parameter in GWT is removed.

		[NST] **19.** Reduce the minimum time interval (50ms □ 10ms) between packets in NST TX and MFG to improve test speed. **20.** Add Remote command for NST and MFG test function **[Link Analyzer]** 21.Multiple MAC command function in GWT mode becomes available.
V1.170	17/June/2019	**[LoRaWAN]** **[Pre-Certification]** 1. Improve EU10.2 certification procedure to verify behavior of confirmed uplink retransmission with NAK reply and without any response. 2. Fixed the bug by adding NewChannelReq procedure in IN13.1 certification for FSK PER testing. **[RF Performance]** 3. In TX Power measurement, added the parameter to set the minimum number of packets per channel [3~100]. 4. In Scenario of sensitivity, DL_CNT mode is added. In this mode RWC5020A uses DLcounter packets to test PER. 5. DL channel frequency parameters are added to modify downlink frequency in sensitivity of EDT. 6. Target channel mask parameter is added in sensitivity test of GWT. 7. Change Pop-up value list of UPLINK_DR, RX2_DR, PING_DR, BEACON_DR, REJOIN_DR parameters from [DR_0, DR_1, DR_2, DR_3, DR_4, DR_5, DR_6, DR_7] to [DR0_SF12BW125, DR1_SF11BW125, DR2_SF10BW125, DR3_SF9BW125, DR4_SF8BW125, DR5_SF7BW125, DR6_SF7BW250, DR7_FSK50]. 8. Combine Power channel and Power time screen into Power measure screen. In this single screen, user can select one of

		power channel and power time mode. 9. Added TX Power measure scenario to measure TX power of DUT in specific scenarios. **[NST]** **[Link Analyzer]** 10. Add CONF:LINK:ABNORMAL remote command for abnormal behavior testing like NO_RSP, MIC_ERR, etc.… 11. Modify PING_FREQ, PING_DR, BC_FREQ, CW_TIMEOUT, CW_FREQ, CW_POWER, ECHO_LEN parameters as array type for multi mac command function with different setting value. 12. Delete CONF:LINK:BEACON:DR, READ:LINK:BEACON:DR? remote command 13. Add READ:RF:PING_FREQ?, READ:RF:PING_DR?, READ:RF:BC_FREQ?, READ:RF:BC_DR? 14. Add CONF:LINK:RX2_FREQ, READ:LINK:RX2_FREQ?, CONF:LINK:RX2_DR, READ:LINK:RX2_DR?, CONF:LINK:RECEIVE_DELAY, READ:LINK:RECEIVE_DELAY?
V1.160	12/APR/2019	**[LoRaWAN]** 1. Chang the default DEV_ADDR value from 0 to 1. **[Pre-Certification]** 2. Warning message was not appropriate when DUT cannot receive Join accept message in US Cert 2.1 3. In US Cert 4.3, RWC5020A checked ACK flag only in DLcounter packet. If DUT transmitted ACK flag using other packets, RWC5020A ignored. It is fixed to check any kind of packets. 4. Chang the Max DR value from 7 to 5 in AS Cert 10.2 & 10.4 **[RF Performance]** 5. The TX power measurement function had an error that only worked when the EU Certi option was present. **[NST]** **[Link Analyzer]** 6. Added function to modify foption field for customer MAC command. 15. 7. For Class B testing in GWT mode, several scenarios are required to create Class B connection. In previous version,

		RWC5020A sent User MAC command with Class B flag. The RWC5020A now uses LinkCheckReq MAC command for Class B switching.
V1.150	15/DEC/2018	**[LoRaWAN]** 1. Changed to display all of KEY and EUI values regardless of activation mode. 2. Fixed a bug of NETWORK parameter setting. Sometimes, NETWORK parameter was not applied to RF signal. 3. Added NTT operator to AS923 and LIANSHU operator to CN470. **[Pre-Certification]** 4. Some DUT transmit confirmed DLcounter packets after enabling test mode. EU Cert 15.12 Redundancy test item must be tested with unconfirmed DLcounter packets. So it is improved to transmit Unconfirmed frame command at the beginning stage of this Certification test. 5. Fixed a bug of Echo response decoder. When DUT re-transmit Echo response, RWC5020A displayed it as another type of command instead of Echo response. **[RF Performance]** 6. Added receiver sensitivity test mode for Class B. If the class is set as B, RWC5020A uses ping slot for PER testing. 7. Fixed a bug in RX sensitivity test by checking ACK flag too when DUT sends Confirmed UL message periodically. In previous version, only FCnt value was checked for error counting. 8. Extended the range of TIME_OFFSET value to +/- 10ms. 9. Added TX power measurement with Normal UL mode. 10. Improved to display comment messages while RX sensitivity test is running. **[NST]** 11. Fixed a bug of SF in MFG. If SF set as ANY, RWC5020A should have received any type of SF from DUT. **[Link Analyzer]** 12. Added Remote commands (READ:LINK:MAC_SEND_STATUS?,

		READ:LINK:MAC_SEND_RESULT?) to read MAC command transmission status and result.
V1.140	10/OCT/2018	**[LoRaWAN]** 1. Improved Class B operation by compatibility test with real Class B products. In Link Analyzer, graphical display was added for understanding of Class B operation. In End Device Test, downlink packets can be transmitted periodically via ping slots. 2. Added a special downlink channel other than RX1 and RX2 in Class C, named as RX_C. 3. Renamed channel plan of regional parameters as common name defined in LoRaWAN Regional Parameters v1.0.3. 4. Fixed a bug of decryption in case MAC command is contained in FOption field. 5. Updated definition of UL DR in AU915 by adding SF12 and SF11. 6. Applied Effective_RX1DROffset (RX1DROffeset is 6 or 7) for AS and IN regions. **[Pre-Certification]** 7. Added test cases for optional DR (SF7BW250, FSK50) **[RF Performance]** 8. Changed PER test item from SF to DR and added optional DR. 9. Added 500kHz uplink channel for receiver sensitivity test for Gateway Test 10. Added ANY as a type of SF in MFG test, in order to make it possible to receive any type of SF which DUT sends. So the SF of test packets can be determined same as the one of START FLAG packet of DUT. Added FSK modulation. 11. Fixed a bug in TX power measurement by eliminating the first unexpected power measurement. **[NST]** 12. Added ANY as a type of SF in NST RX, the tester can receive any type of SF using 125kHz BW. 13. Added FSK modulation. **[Link Analyzer]**

		14. When MAC command is selected as USER_DEFINED, CMD FIELD is restricted to PAYLOAD. 15. In case MAC command is contained in FOption field, { } is used in command name to distinguish. 16. Removed SET_CH_MASK parameter, which was applicable only to 64 channels of US915 and AU915 and became useless.
V1.130	19/JUL/2018	**[LoRaWAN]** 1. Certified by LoRa End Device Certification EU868 2. Certified by LoRa End Device Certification KR920 3. Support of LoRaWAN V1.0.3 4. Support of Russian regional parameters **[Pre-Certification]** 5. Implemented updated versions of LoRaWAN Certifications; US V1.3, KR V1.2, AS V1.1 and IN V1.0 (new) 6. Fixed a bug in case of PACKET_NUM less than 10 in US Pre-Certification 10.1 and 10.2 Receive Window Tests. 7. Fixed a bug of tester reset in case when the tester receives Join-request message again from DUT in OTAA test 8. Implemented additional test items for SKT 41 to 46 **[RF Performance]** 9. Improved TX Power measurement of DUT in RF Performance Test by adding CW mode, which is the same way as used in LoRaWAN RF Performance Test 10. Added MFG function for fast receiver sensitivity tests in NST mode, applicable to manufacturing lines **[NST]** 11. Fixed bugs of running status in Signal Analyzer of NST 12. Disabled automatic running of Signal Analyzer in NST mode due to inconvenience **[Link Analyzer]** 13. Added a function of Periodic Downlink in Class C mode of EDT 14. Added the stop function of MAC command transmission 15. Added calculation of dwell time in Link Analyzer 16. Implemented reply retransmission of RxParamSetupAns,

		RxTimingSetupAns, and DlChannelAns in case of absence of a downlink message 17. Renamed a parameter SET_TM_AT_OTAA as SET_TEST_MODE and moved to sub-parameter of ACTIVATION 18. Renamed a parameter SET_CH_AT_OTAA as SET_CH_MASK and moved to sub-parameter of ACTIVATION, shown only in case of US915 region
V1.120	25/APR/2018	1. Added a standard test solution for manufacturing lines to test TX and RX of devices simultaneously 2. Verified and improved all test procedures of EU, US/CA, AS, and KR Certification Tests based on comparison of KR Certification with other test lab 3. Modified default channel frequencies of Europe to be matched with the local regulation 4. Changed the max number of channels supported in Europe and India to 7 due to limitation of hardware. 5. Added MAC commands related with certification test mode; COMFIRMED_TM, UNCONFIRMED_TM, ECHO_REQUEST_TM, TRIGGER_JOIN_REQ_TM, and ENABLE_CW_MODE_TM 6. Added a function of duty cycle measurement in EDT Link Analyzer 7. Added protocol parameters in Link Analyzer screen for users' convenience such as DR, RxDelay, ADRACKReq and FPending 8. Minor bug fixes and updates
V 1.110	20/MAR/2018	1. Improved Signal Generator and Signal Analyzer of NST; providing various configurable MAC parameters in order to send and receive LoRaWAN frames 2. Enabled modification of part of channel frequencies; the first frequency of the second channel group (4~7) can be modified 3. Added more commands in MAC command transmission: *ForceRejoinReq*, *RejoinParamSetupReq*, and

		ADRParamSetupReq for EDT*; ResetInd* for GWT. 4. Added display of Activation status at the bottom of the screen 5. Minor bug fixes and updates
V 1.100	22/DEC/2017	1. Support of LoRaWAN V1.1 2. Changed Class B operation to match with LoRaWAN V1.0.2classB-draft4 3. Improved control of minimum TX power level for DUT's RX sensitivity test - the minimum TX power is -150dBm 4. Added a flag to determine whether to force DUT to enter Test Mode by sending *Activate Test Mode* command actions after activation 5. Added a flag to determine whether to configure channel masks by sending multiple *LinkADRReq* commands actions after activation 6. Added a flag to determine whether to display erroneous frames in Link Analyzer screen
V 1.060	08/NOV/2017	1. Release of implementation of Certification Tests - Final version of implementation for US/CA V1.2 2. Support of Class B in LoRaWAN V1.0.2 3. Included V1.051 patch - fixed bugs in implementation of Certification EU V1.5 in Firmware version of V1.05 4. Added display items in Link Analyzer - Measured power, ADR flag, and Class B flag 5. Changed position of contents in Link Analyzer - from right column to bottom 6. Enhanced functionality and stability of RF performance test (receiver sensitivity and TX power) 7. Added or modified remote control commands (refer to the version history in User Manual) 8. Minor bug fixes and updates

V 1.050	13/SEP/2017	1. Release of implementation of Certification Tests - Final version of implementation for EU V1.5, AS V1.0 and KR V1.1 - draft version of implementation for US/CA V1.2 2. In GWT, RF channels are fully are supported up to 64+8 channels for US/CA 915 and AU 921, and up to 96 channels for CN 490. 3. Improved a function of MAC commands transmission - Support for multiple MAC commands in a single frame - Added commands: DL_CHANNEL, ACTIVATE_TM, DEACTIVATE_TM 4. Added or modified remote control commands (refer to the version history in User Manual) 5. Improved RF Performance Test function - Test Scenario: Normal Uplink or CERTI_ECHO - Gateway testing available - TX Power measurement according to TXPower index - More reliable by using ACK flag instead of FCntUp 6. Added parameters to control timing offset in us and frequency offset in ppm. 7. Modified the concept of Channel Group from one group with 8 channels to two groups with 4 channels respectively, named as CH_GROUP_A and CH_GROUP_B, in cases of US/CA 915, AU 921 and CN 490.
V 1.040	01/AUG/2017	1. Class C support 2. Fixed bugs in implementation of LoRaWAN Certification EU V1.2 3. Improved Sensitivity Test function - adding Test mode method using Echo Request - selecting RX window and DR 4. Fixed a bug in measuring power of unconfirmed frames 5. Improved the minimum of TX power level down to -143dBm 6. Renamed remote commands for transmission of MAC commands according to hierarchy structure

		7. Minor fixes and updates
V 1.030	04/JUL/2017	1. Fixed bugs in execution of EU Certification Tests 2. Added channel group function 3. Fixed a bug of mis-handling RX1DELAY value 4. Added 'M' field to indicate MTYPE in Link Analyzer and renamed MAC commands to follow the definition of LoRaWAN Spec. 5. Updated a remote command for reading of link messages 6. Added 'PREAMBLE_TYPE' parameter in NST mode 7. Added selection of downlink messages in EDT Sensitivity Test; ACK or user-defined data 8. Added and improved 'pre_alc_calibration' function in normal mode to guarantee the stability of TX power level
V 1.010	07/JUN/2017	1. Added an optional function of SKT Certification Profile (partly verified) 2. Modified the unit for input of path loss and TX power 3. Changed pictures of Main Menu 4. Re-arranged Signal Generator function in NST 5. Defined remote commands fully 6. Verified Save/Recall functions 7. Updated User Manual
V 1.00	31/MAY/2017	1st Official Firmware Release