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RF Exposure Evaluation Report

FCC 47 CFR § 2.1091

for

Connected Digital Recorder

Model Name.: N702

Prepared for:

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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	August 15, 2022	Initial Issue	ALL	Allison Chen
01	August 23, 2022	See the following Note Rev.(01)	P.7-8, 10, 12, 14, 16	Allison Chen
02	September 1, 2022	See the following Note Rev.(02)	ALL	Allison Chen

Note:

Rev.(01)

1. Added NFC RF exposure evaluation and Simultaneous transmission analysis.

Rev.(02)

1. Added WWAN function RF exposure evaluation and simultaneous transmission analysis.

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1 Attestation of Test Results

Applicant Name	Mitac Digital Technology Corporation
Model Name	N702
Applicable Standards	FCC 47 CFR § 2.1091 KDB 447498 D04 FCC 47 CFR § 1.1307 FCC 47 CFR § 1.1310 Published RF exposure KDB procedures
Receive EUT Date:	June 30, 2022
Compliance Certification Services Inc. , tested the above equipment in accordance with the requirements set forth in the above standards. Determination of compliance is based on the results of the compliance measurement,not taking into account measurement instrumentation uncertainty.All indications of Pass/Fail in this report are opinions expressed by Compliance Certification Services Inc, based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.	
Approved & Released By: 	
Sky Zhou Asst. Section Manager Compliance Certification Services Inc.	



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2 Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1091, the following FCC Published RF exposure [KDB](#) procedures:

- 447498 D04 Interim General RF Exposure Guidance v01
- 865664 D02 RF Exposure Reporting v01r02

3 Device Under Test (DUT) Information

3.1 DUT Description

Product	Connected Digital Recorder
Trade Name	MiTAC, Mio, MAGELLAN, Navman
Model No.	N702
Model Discrepancy	Difference of those brand names (list on this report) are just for marketing purpose only.
Hardware Version	R02
Software Version	R01
Sample Stage	Identical prototype

3.2 Wireless Technologies

Frequency bands	☒ Bluetooth: 2402MHz ~ 2480MHz ☒ 802.11b/g/n HT20: 2412 MHz ~ 2462 MHz ☒ 802.11n HT40: 2422 MHz ~ 2452MHz ☒ 802.11a/n HT20: 5180MHz ~ 5240MHz / 5745MHz ~ 5825MHz ☒ 802.11n HT40: 5190MHz ~ 5230MHz / 5755MHz ~ 5795MHz ☒ 802.11ac VHT80: 5210MHz / 5775MHz ☒ 13.56MHz ☒ WCDMA Band II: 1852.4MHz ~ 1907.6MHz ☒ WCDMA Band IV: 1712.4MHz ~ 1752.6MHz ☒ WCDMA Band V: 826.4MHz ~ 846.6MHz ☒ LTE Band 2: 1850.0MHz ~ 1910.0MHz ☒ LTE Band 4: 1710.0MHz ~ 1755.0MHz ☒ LTE Band 5: 824.0MHz ~ 849.0MHz ☒ LTE Band 12: 704.0MHz ~ 716.0MHz ☒ LTE Band 13: 777 MHz ~ 787 MHz ☒ LTE Band 14: 788 MHz ~ 798 MHz ☒ LTE Band 66: 1710 MHz ~ 1780 MHz ☒ LTE Band 71: 663 MHz ~ 698 MHz ☐ Others
Exposure classification	☐ Occupational/Controlled exposure (S = 5mW/cm ²) ☒ General Population/Uncontrolled exposure (S=1mW/cm ² for 1500-100000MHz) (E=60.77 V/m, E=824/f V/m for 1.34-30MHz)

Antenna Specification	PIFA antenna		
	WIFI 2.4GHz & Bluetooth: Gain: 4.2 dBi		
	WIFI 5GHz:		
	5150~5250 MHz, Gain: 2.8 dBi		
	5725~5850 MHz, Gain: 3.3 dBi		
	Bluetooth	Gain : 4.20 dBi (Numeric gain: 2.63)	Worst
	WIFI 2.4GHz	Gain : 4.20 dBi (Numeric gain: 2.63)	Worst
	WIFI 5GHz	Gain : 3.30 dBi (Numeric gain: 2.14)	Worst
	13.56MHz: Loop Antenna / Gain: N/A dBi		
	WWAN: Dipole Antenna		
	WCDMA Band II: 5.30 dBi		
	WCDMA Band IV: 5.20 dBi		
	WCDMA Band V: 2.50 dBi		
	LTE Band 2: 5.30 dBi		
	LTE Band 4: 5.20 dBi		
	LTE Band 5: 2.50 dBi		
	LTE Band 12: 1.30 dBi		
	LTE Band 13: 2.60 dBi		
	LTE Band 14: 2.60 dBi		
	LTE Band 66: 5.20 dBi		
	LTE Band 71: 1.30 dBi		
	Gain :	5.30 dBi (Numeric gain: 3.39)	Worst
	Gain :	5.20 dBi (Numeric gain: 3.31)	Worst
	Gain :	2.60 dBi (Numeric gain: 1.82)	Worst
	Gain :	2.50 dBi (Numeric gain: 1.78)	Worst
	Gain :	1.30 dBi (Numeric gain: 1.35)	Worst

Maximum Measurement Average Power	BT	10.84 dBm	(12.134 mW)
	BLE	1.29 dBm	(1.346 mW)
	2.4GHz		
	IEEE 802.11b Mode:	26.36 dBm	(432.514 mW)
	IEEE 802.11g Mode:	24.63 dBm	(290.402 mW)
	IEEE 802.11n HT 20 Mode:	24.56 dBm	(285.759 mW)
	IEEE 802.11n HT 40 Mode:	24.58 dBm	(287.078 mW)
	5GHz		
	IEEE 802.11a Mode:	22.56 dBm	(180.506 mW)
	IEEE 802.11n HT 20 Mode:	22.40 dBm	(173.583 mW)
	IEEE 802.11n HT 40 Mode:	22.36 dBm	(172.264 mW)
	IEEE 802.11ac VHT 80 Mode:	21.20 dBm	(131.963 mW)
Maximum tune up power	BT	11.00 dBm	(12.589 mW)
	BLE	1.50 dBm	(1.413 mW)
	2.4GHz		
	IEEE 802.11b Mode:	27.00 dBm	(501.187 mW)
	IEEE 802.11g Mode:	25.00 dBm	(316.228 mW)
	IEEE 802.11n HT 20 Mode:	25.00 dBm	(316.228 mW)
	IEEE 802.11n HT 40 Mode:	25.00 dBm	(316.228 mW)
	5GHz		
	IEEE 802.11a Mode:	23.50 dBm	(223.872 mW)
	IEEE 802.11n HT 20 Mode:	23.00 dBm	(199.526 mW)
	IEEE 802.11n HT 40 Mode:	23.00 dBm	(199.526 mW)
	IEEE 802.11ac VHT 80 Mode:	22.50 dBm	(177.828 mW)
Result Power	13.56MHz 57.98 dBuV/m (3m)		
Maximum Conducted Output Power	WCDMA II	25.00 dBm	(316.228 mW)
	WCDMA IV	25.00 dBm	(316.228 mW)
	WCDMA V	25.00 dBm	(316.228 mW)
	LTE Band 2	25.00 dBm	(316.228 mW)
	LTE Band 4	25.00 dBm	(316.228 mW)
	LTE Band 5	25.00 dBm	(316.228 mW)
	LTE Band 12	25.00 dBm	(316.228 mW)
	LTE Band 13	25.00 dBm	(316.228 mW)
	LTE Band 14	25.00 dBm	(316.228 mW)
	LTE Band 66	25.00 dBm	(316.228 mW)

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Notes:

1. For more details, please refer to the User's manual of the EUT.
2. Disclaimer: Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.
3. Disclaimer: The variant trademarks are assessed as identical in hardware and software to each other, hence all variants are fully covered by the test results in this test report without further verification test.
4. Disclaimer: The WWAN tune up power referred the Max Conducted power referred the module report for RF Exposure assessment purpose, the module report was provided by applicant.
5. The tune up power referred the AVG power of the test report TMWK2203000754KR, TMWK2203000755KR, TMWK2203000756KR and TMWK2203000757KR for RF Exposure assessment purpose.
6. The NFC power referred the test report TMWK2203000758KR for RF Exposure assessment purpose.

4 Maximum Permissible Exposure

4.1 Limits for Maximum Permissible Exposure (MPE)

Table 1 - Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	* 100	6
3.0-30	1842/f	4.89/f	* 900/f ²	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* 100	30
1.34-30	824/f	2.19/f	* 180/f ²	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
<u>1,500-100,000</u>			1.0	30

4.2 MPE Calculation Method

Calculation

Given $E = \frac{\sqrt{30 \times P \times G}}{d}$ & $S = \frac{E^2}{377}$

Where E = Field strength in Volts / meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{377 d^2}$$

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = d \text{ (m)} / 100$$

Yields

$$S = \frac{30 \times (P/1000) \times G}{377 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \text{ Equation 1}$$

Where d = Distance in cm

P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²

If, Substituting the MPE safe distance using d = 20 cm into Equation 1:

$$S = 0.000199 \times P \times G$$

Calculation(continued)

Given $R = R_3 + 40 \log(3 / 0.2)$ or $R = R_3 + 40 \log(3 / 0.15)$

$$E = 10^{((R-12)/20)}$$

Where E = E field Strength

R₃ = Result Power on 3m

R = Result Power on 0.2m or 0.15m

4.3 MPE EXEMPTION

- (A) The available maximum time-averaged power is no more than 1 mW
- (B) The available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

- (C) Using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Single RF Sources Subject to Routine Environmental Evaluation	
RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$.
1.34-30	$3,450 R^2/f^2$.
30-300	$3.83 R^2$.
300-1,500	$0.0128 R^2 f$.
1,500-100,000	$19.2 R^2$.
Note: R is in meters, f is in MHz.	

4.4 Multiple RF sources

In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation),

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

5 Radio Frequency Radiation Max Exposure Evaluation

Substituting the MPE safe distance using $d = 20$ cm into Equation 1:

$$S = 0.000199 \times P \times G$$

Where P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²

Bluetooth

Mode	Frequency (MHz)	Max Tune-up power(dBm)	Max Tune-up power(mW)	G(dBi)	G(num.)	D(cm)	Power Density in mW/cm2	Power Density in mW/cm2
BT	2480.00	11.00	12.59	4.20	2.63	20.0	0.007	1.000
BLE	2480.00	1.50	1.41	4.20	2.63	20.0	0.001	1.000

WIFI 2.4GHz

Mode	Frequency (MHz)	Max Tune-up power(dBm)	Max Tune-up power(mW)	G(dBi)	G(num.)	D(cm)	Power Density in mW/cm2	Power Density in mW/cm2
IEEE 802.11b	2462.00	27.00	501.19	4.20	2.63	20.0	0.262	1.000
IEEE 802.11g	2462.00	25.00	316.23	4.20	2.63	20.0	0.165	1.000
IEEE 802.11n HT 20	2462.00	25.00	316.23	4.20	2.63	20.0	0.165	1.000
IEEE 802.11n HT 40	2452.00	25.00	316.23	4.20	2.63	20.0	0.165	1.000

WIFI 5GHz

Mode	Frequency (MHz)	Max Tune-up power(dBm)	Max Tune-up power(mW)	G(dBi)	G(num.)	D(cm)	Power Density in mW/cm2	Power Density in mW/cm2
IEEE 802.11a	5825.00	23.50	223.87	3.30	2.14	20.0	0.095	1.000
IEEE 802.11n HT 20	5825.00	23.00	199.53	3.30	2.14	20.0	0.085	1.000
IEEE 802.11n HT 40	5795.00	23.00	199.53	3.30	2.14	20.0	0.085	1.000
IEEE 802.11ac VHT 80	5775.00	22.50	177.83	3.30	2.14	20.0	0.076	1.000

WWAN

Mode	Frequency (MHz)	Max Tune-up power(dBm)	Max Tune-up power(mW)	G(dBi)	G(num.)	D(cm)	Power Density in mW/cm2	Power Density in mW/cm2
WCDMA II	1910.00	25.00	316.23	5.30	3.39	20.0	0.213	1.000
WCDMA IV	1755.00	25.00	316.23	5.20	3.31	20.0	0.208	1.000
WCDMA V	849.00	25.00	316.23	2.50	1.78	20.0	0.112	0.566
LTE Band 2	1910.00	25.00	316.23	5.30	3.39	20.0	0.213	1.000
LTE Band 4	1755.00	25.00	316.23	5.20	3.31	20.0	0.208	1.000
LTE Band 5	849.00	25.00	316.23	2.50	1.78	20.0	0.112	0.566
LTE Band 12	716.00	25.00	316.23	1.30	1.35	20.0	0.085	0.477
LTE Band 13	787.00	25.00	316.23	2.60	1.82	20.0	0.114	0.525
LTE Band 14	798.00	25.00	316.23	2.60	1.82	20.0	0.114	0.532
LTE Band 66	1780.00	25.00	316.23	5.20	3.31	20.0	0.208	1.000
LTE Band 71	698.00	25.00	316.23	1.30	1.35	20.0	0.085	0.465

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Given $R = R_3 + 40 \log(3 / 0.2)$ or $R = R_3 + 40 \log(3 / 0.15)$
 $E = 10^{((R-12)/20)}$

Where E = E field Strength
R₃ = Result Power on 3m
R = Result Power on 0.2m or 0.15m

NFC

Mode	Frequency (MHz)	D(m)	Result power (dBuV/m)	Electric Field Strength (V/m)	Limit of Electric Field Strength (V/m)
NFC	13.56	0.2	57.98	0.18	60.77

6 MPE Exemption Option B

Bluetooth

Mode	Frequency (MHz)	R(m)	Max Tune-up EIRP(dBm)	Max Tune-up ERP(dBm)	Max Tune-up ERP(mW)	ERP Threshold(mW)	MPE Exemption
BT	2480.00	0.2	15.20	13.05	20.184	3060	Complies
BLE	2480.00	0.2	5.70	3.55	2.265	3060	Complies

WIFI 2.4GHz

Mode	Frequency (MHz)	R(m)	Max Tune-up EIRP(dBm)	Max Tune-up ERP(dBm)	Max Tune-up ERP(mW)	ERP Threshold(mW)	MPE Exemption
IEEE 802.11b	2462.00	0.2	31.20	29.05	803.526	3060	Complies
IEEE 802.11g	2462.00	0.2	29.20	27.05	506.991	3060	Complies
IEEE 802.11n HT 20	2462.00	0.2	29.20	27.05	506.991	3060	Complies
IEEE 802.11n HT 40	2452.00	0.2	29.20	27.05	506.991	3060	Complies

WIFI 5GHz

Mode	Frequency (MHz)	R(m)	Max Tune-up EIRP(dBm)	Max Tune-up ERP(dBm)	Max Tune-up ERP(mW)	ERP Threshold(mW)	MPE Exemption
IEEE 802.11a	5825.00	0.2	26.80	24.65	291.743	3060	Complies
IEEE 802.11n HT 20	5825.00	0.2	26.30	24.15	260.016	3060	Complies
IEEE 802.11n HT 40	5795.00	0.2	26.30	24.15	260.016	3060	Complies
IEEE 802.11ac VHT 80	5775.00	0.2	25.80	23.65	231.739	3060	Complies

WWAN

Mode	Frequency (MHz)	R(m)	Max Tune-up EIRP(dBm)	Max Tune-up ERP(dBm)	Max Tune-up ERP(mW)	ERP Threshold(mW)	MPE Exemption
WCDMA II	1910.00	0.2	30.30	28.15	653.131	3060	Complies
WCDMA IV	1755.00	0.2	30.20	28.05	638.263	3060	Complies
WCDMA V	849.00	0.2	27.50	25.35	342.768	1732	Complies
LTE Band 2	1910.00	0.2	30.30	28.15	653.131	3060	Complies
LTE Band 4	1755.00	0.2	30.20	28.05	638.263	3060	Complies
LTE Band 5	849.00	0.2	27.50	25.35	342.768	1732	Complies
LTE Band 12	716.00	0.2	26.30	24.15	260.016	1461	Complies
LTE Band 13	787.00	0.2	27.60	25.45	350.752	1605	Complies
LTE Band 14	798.00	0.2	27.60	25.45	350.752	1628	Complies
LTE Band 66	1780.00	0.2	30.20	28.05	638.263	3060	Complies
LTE Band 71	698.00	0.2	26.30	24.15	260.016	1424	Complies

7 Simultaneous Transmission Analysis

In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation),

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations							
	1	WWAN	+	DTS	+	BT	+	NFC	
	2	WWAN	+	U-NII	+	BT	+	NFC	

Notes:
1. DTS cannot transmit simultaneously with U-NII.

7.1 Sum of the WWAN & Wi-Fi 2.4GHz & BT & NFC

$$(0.114/0.525)+(0.262/1)+(0.007/1)+(0.18/60.77)=0.489 \leq 1$$

7.2 Sum of the WWAN & Wi-Fi 5GHz & BT & NFC

$$(0.114/0.525)+(0.095/1)+(0.007/1)+(0.18/60.77)=0.322 \leq 1$$



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8 Facilities

All measurement facilities used to collect the measurement data are located at

☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City, Taiwan. (R.O.C.)

END OF REPORT