Table K.2-2: Uplink-downlink configurations

Configuration	Periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

According to Figure G.2-1, one radio frame is configured by 10 subframes, which consist of Uplink-subframe, Downlink-subframe and Special subframe. For TDD-LTE, the Duty Cycle should be calculated on Uplink-subframes and Special subframes, due to Special subframe containing both Uplink transmissions. So for one radio frame, Duty Cycle can be calculated with formula as below. The count of Uplink subframes are according to Table G.2-2:

Duty cycle = (30720Ts*Ups+Uplink Component*Specials)/ (307200Ts)

About the uplink component of Special subframes, we can figure out by Table G.2-1:

Uplink Component=UpPTS

In conclusion, for the TDD LTE Band, Duty Cycle can be calculated with formula as below all these sets are ok when we test, or we can set as below.

Duty cycle = [(30720Ts*Ups) + UpPTS *Specials]/ (307200Ts)

And we can get different Duty cycles under different configurations:

Uplink-Downlink configuration	Subframe number			Configuration of special subframe							
				Normal cyclice prefix in downlink				Extended cyclice prefix in downlink			
				Normal cyclice prefix in uplink		Extended cyclice prefix in uplink		Normal cyclice prefix in uplink		Extended cyclice prefix in uplink	
	D	S	U	configuration 0~4	configuration 5~9	configuration 0~4	configuration 5~9	configuration 0~3	configuration 4~7	configuration 0~3	configuration 4~7
0	2	2	6	61.43%	62.85%	61.67%	**63.33%**	61.43%	62.85%	61.67%	**63.33%**
1	4	2	4	41.43%	42.85%	41.67%	43.33%	41.43%	42.85%	41.67%	43.33%
2	6	2	2	21.43%	22.85%	21.67%	23.33%	21.43%	22.85%	21.67%	23.33%
3	6	1	3	30.71%	31.43%	30.83%	31.67%	30.71%	31.43%	30.83%	31.67%
4	7	1	2	20.71%	21.43%	20.83%	21.67%	20.71%	21.43%	20.83%	21.67%
5	8	1	1	10.71%	11.43%	10.83%	11.67%	10.71%	11.43%	10.83%	11.67%
6	3	2	5	51.43%	52.85%	51.67%	53.33%	51.43%	52.85%	51.67%	53.33%

For LTE TDD test, power class using uplink-downlink configuration 0 and special subframe configuration 7 for frome structure type to perform SAR with the highest Pcmax frame-average configuration, and UL duty cycle =63.3%.

K.3. SAR test Plan

For each band, the SAR evaluation uses the highest P_{cmax} frame-average configuration.

(1) For 5G NR test, using factory test mode to perform SAR with the highest P_{cmax} frame-average configuration, and UL duty cycle =100%.

(2) For LTE TDD test, power class using uplink-downlink configuration 0 and special subframe configuration 7 for frame structure type to perform SAR with the highest P_{cmax} frame-average configuration, and UL duty cycle =63.3%.

K.4. SAR Comparative measurements for all configurations

(1) SAR Comparative measurements for 9 sets UL duty cycle configuration of n41:

Test No.	Ant	Band	Test Position	Mode	Bandwidth	scs (KHz)	Channel	RB	offset	UL duty cycle	Duty cycle division factor	P_{cmax} (Tune-up) (dBm)	P_{cmax} (Meas.) (dBm)	P_{cmax} frame-average (dBm)	Scaling Factor	SAR 1g (W/kg)	Reported 1g SAR (W/kg)	Drift (dB)	Date
T51	1	n41	Right Cheek	DFT-s-OFDM QPSK	100M	30	518598	135	67	10%	-10.00	24.50	24.48	14.50	1.00	0.467	0.469	-0.047	2/15
T52	1	n41	Right Cheek	DFT-s-OFDM QPSK	100M	30	518598	135	67	20%	-6.99	24.50	24.49	17.51	1.00	0.522	0.523	0.000	2/15
T53	1	n41	Right Cheek	DFT-s-OFDM QPSK	100M	30	518598	135	67	30%	-5.23	23.50	23.10	18.27	1.10	0.553	0.606	0.094	2/15
T54	1	n41	Right Cheek	DFT-s-OFDM QPSK	100M	30	518598	135	67	40%	-3.98	22.00	21.70	18.02	1.07	0.586	0.628	-0.069	2/15
T55	1	n41	Right Cheek	DFT-s-OFDM QPSK	100M	30	518598	135	67	50%	-3.01	21.50	21.40	18.49	1.02	0.621	0.635	-0.090	2/15
T56	1	n41	Right Cheek	DFT-s-OFDM QPSK	100M	30	518598	135	67	60%	-2.22	20.50	20.04	18.28	1.11	0.604	0.671	0.002	2/15
T57	1	n41	Right Cheek	DFT-s-OFDM QPSK	100M	30	518598	135	67	70%	-1.55	20.00	19.61	18.45	1.09	0.613	0.671	0.013	2/15
T58	1	n41	Right Cheek	DFT-s-OFDM QPSK	100M	30	518598	135	67	80%	-0.97	19.00	18.62	18.03	1.09	0.590	0.644	0.101	2/15
T59	1	n41	Right Cheek	DFT-s-OFDM QPSK	100M	30	518598	135	67	100%	0.00	18.50	17.59	18.50	1.23	0.626	**0.772**	0.086	2/15

When the UL duty cycle is 10%, 20%, 30%, 40%, 50%, 60%, and 70%, we use the radio communication tester to establish the connection;

When the UL duty cycle is 80% and 100%, we use the factory test mode.

The results show that the highest P_{cmax} frame-average configuration (UL duty cycle = 100%) has the highest SAR value.

(2) SAR Comparative measurements for 6 sets UL duty cycle configuration of LTE B38:

Test No.	Ant	Band	Test Position	Mode	Bandwidth	Channel	RB	Offset	UL duty cycle	Duty cycle division factor	P_{cmax} (Tune-up) (dBm)	P_{cmax} (Meas.) (dBm)	P_{cmax} frame-average (dBm)	SAR 1g (W/kg)	Scaling Factor	Reported 1g SAR (W/kg)	Drift (dB)	Date
T41	1	LTE B38	Right Cheek	QPSK	20M	38000	1	0	11.7%	-9.32	23.00	22.70	13.68	0.364	1.07	0.390	0.005	2/15
T42	1	LTE B38	Right Cheek	QPSK	20M	38000	1	0	23.3%	-6.33	23.00	22.60	16.67	0.505	1.10	0.554	-0.007	2/15
T43	1	LTE B38	Right Cheek	QPSK	20M	38000	1	0	31.7%	-4.99	22.50	22.20	17.51	0.493	1.07	0.528	0.078	2/15
T44	1	LTE B38	Right Cheek	QPSK	20M	38000	1	0	43.3%	-3.64	22.00	21.70	18.36	0.554	1.07	0.594	-0.005	2/15
T45	1	LTE B38	Right Cheek	QPSK	20M	38000	1	0	53.3%	-2.73	21.00	20.70	18.27	0.527	1.07	0.565	0.072	2/15
T46	1	LTE B38	Right Cheek	QPSK	20M	38000	1	0	63.3%	-1.99	20.50	20.20	18.51	0.580	1.07	**0.621**	0.083	2/15

Uplink-downlink configuration 0,1,2,3,4,5,6 respectively and special subframe configuration 7.

The results show that the highest P_{cmax} frame-average configuration (uplink-downlink configuration 0 and special subframe configuration 7, and UL duty cycle =63.3%) has the highest SAR value.

K.5. Power measurements for SAR test mode

(1) Power Measurement Overview

Table K.5-1: n41

UL duty cycle	Max UL duty cycle	Max UL duty cycle factor	Poffset	Pcmax (dBm)	Pcmax frame-average (dBm)	Power measurement (dBm)	SAR test?	Highest SAR?
0%≤ K1 ≤10%	10%	-10.00	10.00	24.50	14.50	24.48	/	/
10%< K2 ≤20%	20%	-6.99	6.50	24.50	17.51	24.49	/	/
20%< K3≤ 30%	30%	-5.23	5.00	23.50	18.27	23.10	/	/
30%< K4 ≤40%	40%	-3.98	3.50	22.00	18.02	21.70	/	/
40%< K5 ≤50%	50%	-3.01	3.00	21.50	18.49	21.40	/	/
50%< K6 ≤60%	60%	-2.22	2.00	20.50	18.28	20.04	/	/
60%< K7 ≤70%	70%	-1.55	1.50	20.00	18.45	19.61	/	/
70%< K8 ≤80%	80%	-0.97	0.50	19.00	18.03	18.62	/	/
80% <K9 ≤100%	100%	0.00	0.00	18.50	18.50	**17.59**	**yes**	**yes**

Note : We set the $\mathbf{P_{max}}$ and $\mathbf{P_{SAR}}$ parameters of n41 as $\mathbf{P_{max}}$ **= 24.50 (dBm)** and $\mathbf{P_{SAR}}$ **= 6.00 (dB)** respectively,
according to $\mathbf{P_{cmax} = P_{max} - Max(P_{SAR} - P_{offset}}$ **@kn, 0)**
and $\mathbf{P_{cmax}}$ **frame-average =** $\mathbf{P_{cmax}}$ **+ Max UL duty cycle factor**,
The calculation results of $\mathbf{P_{cmax}}$ and $\mathbf{P_{cmax}}$ **frame-average** for each UL duty cycle are shown in the table K.2.

Table G.5-2: LTE TDD B38

UL duty cycle	Max UL duty cycle	Max UL duty cycle factor	P_{offset}	P_{cmax} (dBm)	P_{cmax} frame-average (dBm)	Power measurement (dBm)	SAR test?	Highest SAR?
0%< K1 ≤20%	11.7%	-9.32	5.00	23.00	13.68	22.70	/	/
20%< K2≤ 30%	23.3%	-6.33	3.50	23.00	16.67	22.60	/	/
30%< K3 ≤40%	31.7%	-4.99	2.00	22.50	17.51	22.20	/	/
40%< K4 ≤50%	43.3%	-3.64	1.50	22.00	18.36	21.70	/	/
50%< K5 ≤60%	53.3%	-2.73	0.50	21.00	18.27	20.70	/	/
60%< K6 ≤63.3%	**63.3%**	**-1.99**	**0.00**	**20.50**	**18.51**	**20.20**	**yes**	**yes**

Note : We set the $\mathbf{P_{max}}$ and $\mathbf{P_{SAR}}$ parameters of B38 as $\mathbf{P_{max}}$ **= 23.00 (dBm)** and $\mathbf{P_{SAR}}$ **= 2.50 (dB)** respectively,
according to $\mathbf{P_{cmax} = P_{max} - Max(P_{SAR} - P_{offset}}$ **@kn, 0)**
and $\mathbf{P_{cmax}}$ **frame-average =** $\mathbf{P_{cmax}}$ **+ Max UL duty cycle factor**,
The calculation results of $\mathbf{P_{cmax}}$ and $\mathbf{P_{cmax}}$ **frame-average** for each UL duty cycle are shown in the table K.3.

(2) Detailed power measurement results of 9 sets UL duty cycle configuration for n41:

0%≤ K1 ≤10% (The mobile phone is connected to the radio communication tester)

Set UL duty cycle=10%, P_{max} = 24.50 (dBm) and P_{SAR} = 6.00 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} - P_{offset} @k1, 0) = 24.50-Max(6.00-10,0) = 24.50 (dBm), P_{cmax}(meas.)=24.48 (dBm).

P_{cmax} (Meas.)(dBm)	24.48	UL duty cycle (Meas.)	10%

10%< K2 ≤20% (The mobile phone is connected to the radio communication tester)

Set UL duty cycle=20%, P_{max} = 24.50 (dBm) and P_{SAR} = 6.00 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} - P_{offset} @k2, 0) = 24.50-Max(6.00-6.5,0) = 24.50 (dBm) , P_{cmax}(meas.)=24.49 (dBm).

P_{cmax} (Meas.)(dBm)	24.49	UL duty cycle (Meas.)	20%

20%< K3≤ 30% (The mobile phone is connected to the radio communication tester)

Set UL duty cycle=30%, P_{max} = 24.50 (dBm) and P_{SAR} = 6.00 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} – P_{offset}@k3, 0) = 24.50-Max(6.00-5,0) = 23.50 (dBm) , P_{cmax}(meas.)=23.10 (dBm).

P_{cmax} (Meas.)(dBm)	23.10	UL duty cycle (Meas.)	30%

30%< K4 ≤40% (The mobile phone is connected to the radio communication tester)

Set UL duty cycle=40%, P_{max} = 24.50 (dBm) and P_{SAR} = 6.00 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} – P_{offset} @k4, 0) = 24.50-Max(6.00-3.5,0) = 22.00 (dBm) , P_{cmax}(meas.)=21.70 (dBm).

P_{cmax} (Meas.)(dBm)	21.70	UL duty cycle (Meas.)	40%

40%< K5 ≤50% (The mobile phone is connected to the radio communication tester) Set UL duty cycle=50%, P_{max} = 24.50 (dBm) and P_{SAR} = 6.00 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} – P_{offset} @k5, 0) = 24.50-Max(6.00-3,0) = 21.50 (dBm) , P_{cmax}(meas.)=21.40 (dBm).			
P_{cmax} (Meas.)(dBm)	21.40	UL duty cycle (Meas.)	50%
			
50%< K6 ≤60% (The mobile phone is connected to the radio communication tester) Set UL duty cycle=60%, P_{max} = 24.50 (dBm) and P_{SAR} = 6.00 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} – P_{offset} @k6, 0) = 24.50-Max(6.00-2,0) = 20.50 (dBm) , P_{cmax}(meas.)=20.04 (dBm).			
P_{cmax} (Meas.)(dBm)	20.04	UL duty cycle (Meas.)	60%
			

60%< K7 ≤70% (The mobile phone is connected to the radio communication tester)

Set UL duty cycle=70%, P_{max} = 24.50 (dBm) and P_{SAR} = 6.00 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} – P_{offset}@k7, 0) = 24.50-Max(6.00-1.5,0) = 20.00 (dBm) , P_{cmax}(meas.)=19.61 (dBm).

P_{cmax} (Meas.)(dBm)	19.61	UL duty cycle (Meas.)	70%

70%< K8 ≤80% (The mobile phone is connected to the radio communication tester)

Set UL duty cycle=76%, P_{max} = 24.50 (dBm) and P_{SAR} = 6.00 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} – P_{offset} @k8, 0) = 24.50-Max(6.00-0.5,0) = 19.00 (dBm) , P_{cmax}(meas.)=18.62 (dBm).

P_{cmax} (Meas.)(dBm)	18.62	UL duty cycle (Meas.)	76%

80% <K9 ≤100% (The mobile phone is connected to the radio communication tester)

Set UL duty cycle=88%, P_{max} = 24.50 (dBm) and P_{SAR} = 6.00 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} –

P_{offset}@k9, 0) = 24.50-Max(6.00-0,0) = 18.50 (dBm) , P_{cmax}(meas.)=17.59 (dBm).

When the UL duty cycle is high, such as 100%, the mobile phone and the radio communication tester cannot be established, SAR testing using factory test mode.
SAR testing is performed at P_{cmax}(meas.), and the measurement SAR(P_{cmax} meas.= 17.59 dBm) will be extended to report SAR(P_{cmax} tune up=18.50 dBm)

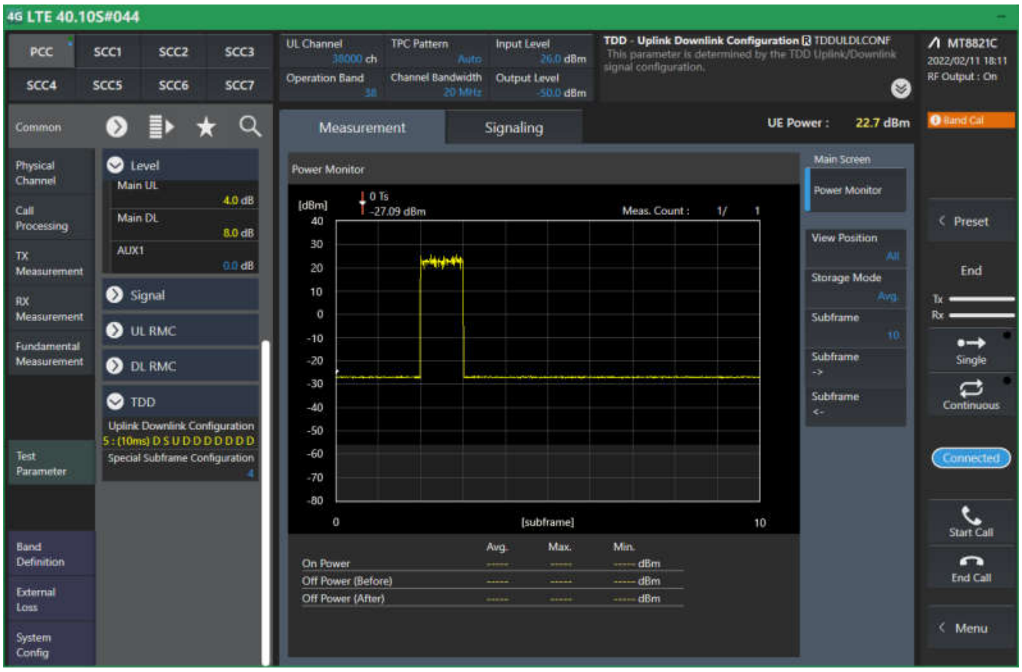
P_{cmax} (Meas.)(dBm)	17.59	UL duty cycle (Meas.)	88%

*If there is only one TDD-UL-DL-Pattern configured, the ULDutyCycle should be:
ULDutyCycle = UL symbols / Total symbols
= (nrofUplinkSymbols + 14 * nrofUplinkSlots) / 14 * Number of Slots via 38.213 v16.5 -11.1
*If there is more than one TDD-UL-DL-Pattern configured, the ULDutyCycle should be:
ULDutyCycle = (UL symbols(pattern 1) + UL symbols(pattern 2) [+ ...]) / 14 * (Number of Slots in pattern1 + pattern2 [+ ...])
*If dl-UL-TransmissionPeriodicity-v1530 is conifgured, the UL Duty Cycle should follow dl-UL-TransmissionPeriodicity-v1530 instead.

Note: FDD NR has the same characteristics as TDD NR.

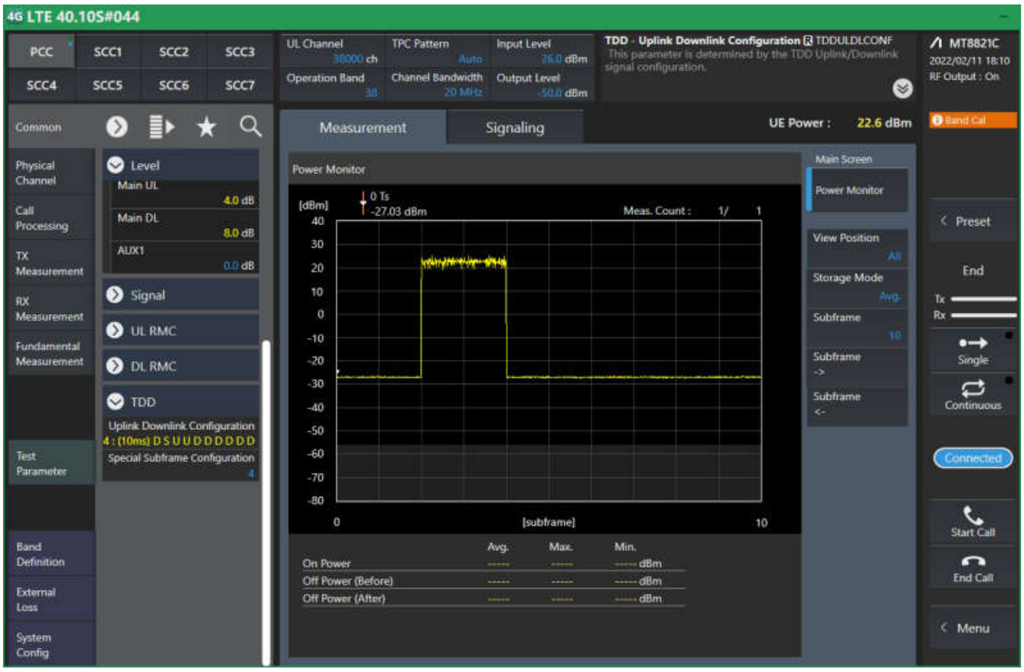
(3) Detailed power measurement results of 6 sets UL duty cycle configuration for B38:

0%< K1 ≤20% (Config5)	P_{cmax} (Meas.)(dBm)	22.70	UL duty cycle (Meas.)	10.71%~11.67%
Set UL duty cycle=10.71% (uplink-downlink configuration 5 and special subframe configuration 4), P_{max} = 23.00 (dBm) and P_{SAR} = 2.50 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} – P_{offset} @k1, 0) = 23.00-Max(2.50-5,0) = 23.00 (dBm) , P_{cmax}(meas.)=22.70 (dBm).				

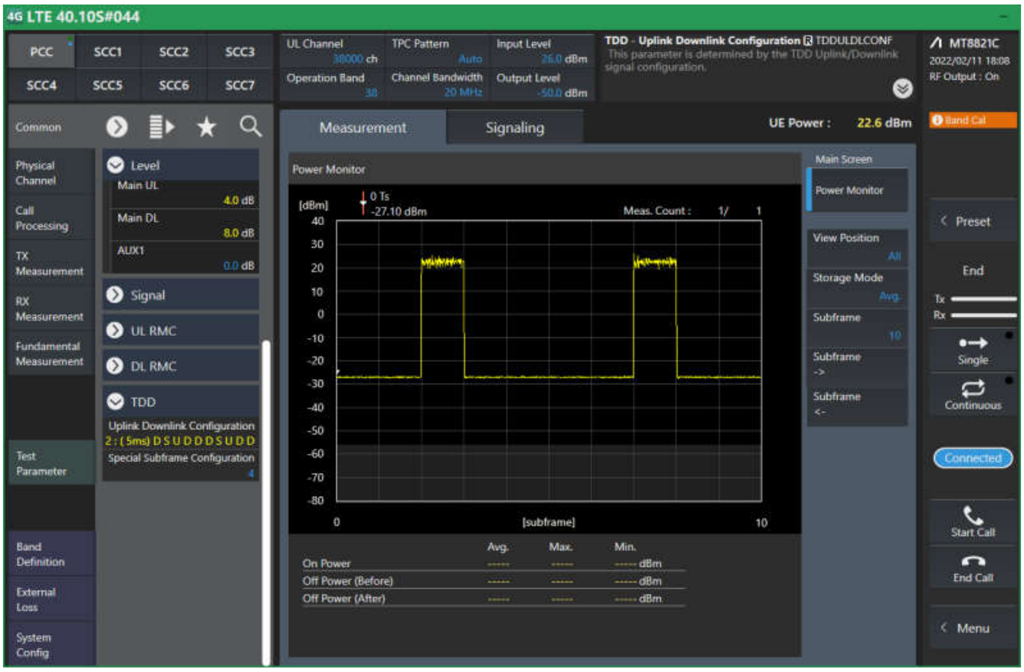


20%< K2≤ 30% (Config4)	P_{cmax} (Meas.)(dBm)	22.60	UL duty cycle (Meas.)	20.71%~21.67%

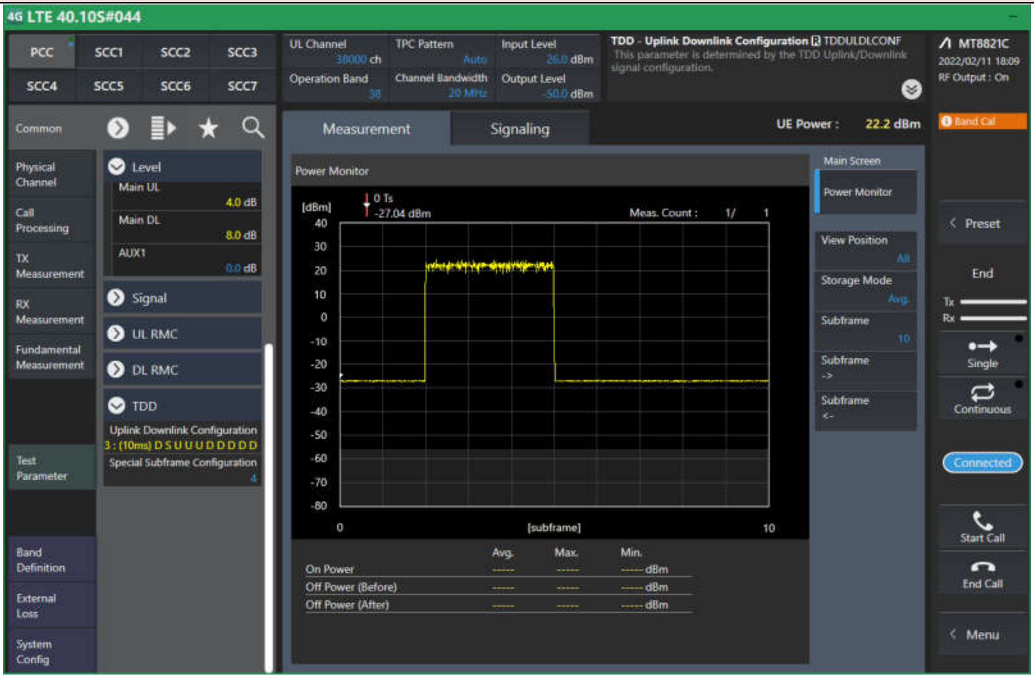
Set UL duty cycle=20.71% (uplink-downlink configuration 4 and special subframe configuration 4), P_{max} = 23.00 (dBm) and P_{SAR} = 2.50 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} – P_{offset}@k2, 0) = 23.00-Max(2.50-3.5,0) = 23.00 (dBm) , P_{cmax}(meas.)=22.60 (dBm).



20%< K2≤ 30% (Config2)	P_{cmax} (Meas.)(dBm)	22.60	UL duty cycle (Meas.)	21.43%~23.33%
Set UL duty cycle=21.43% (uplink-downlink configuration 2 and special subframe configuration 4), P_{max} = 23.00 (dBm) and P_{SAR} = 2.50 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} – P_{offset}@k2, 0) = 23.00-Max(2.50-3.5,0) = 23.00 (dBm) , P_{cmax}(meas.)=22.60 (dBm).				

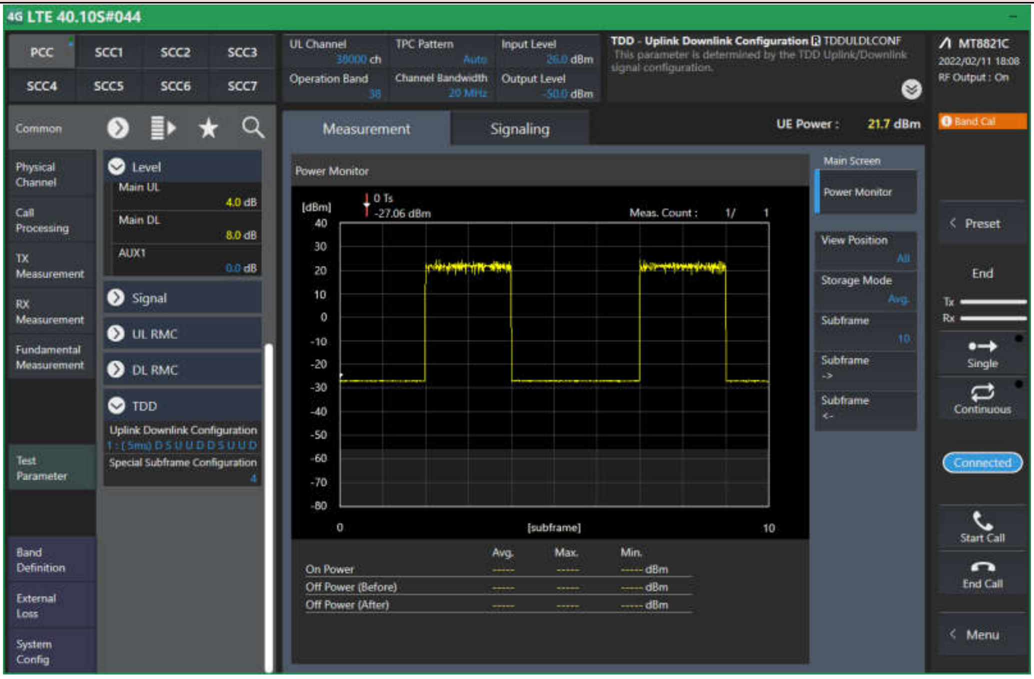


30%< K3 ≤40% (Config3)	P_{cmax} (Meas.)(dBm)	22.20	UL duty cycle (Meas.)	30.71%~31.67%
Set UL duty cycle=30.71% (uplink-downlink configuration 3 and special subframe configuration 4), P_{max} = 23.00 (dBm) and P_{SAR} = 2.50 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} –P_{offset} @k3, 0) = 23.00-Max(2.50-2,0) = 22.50 (dBm) , P_{cmax}(meas.)=22.20 (dBm).				

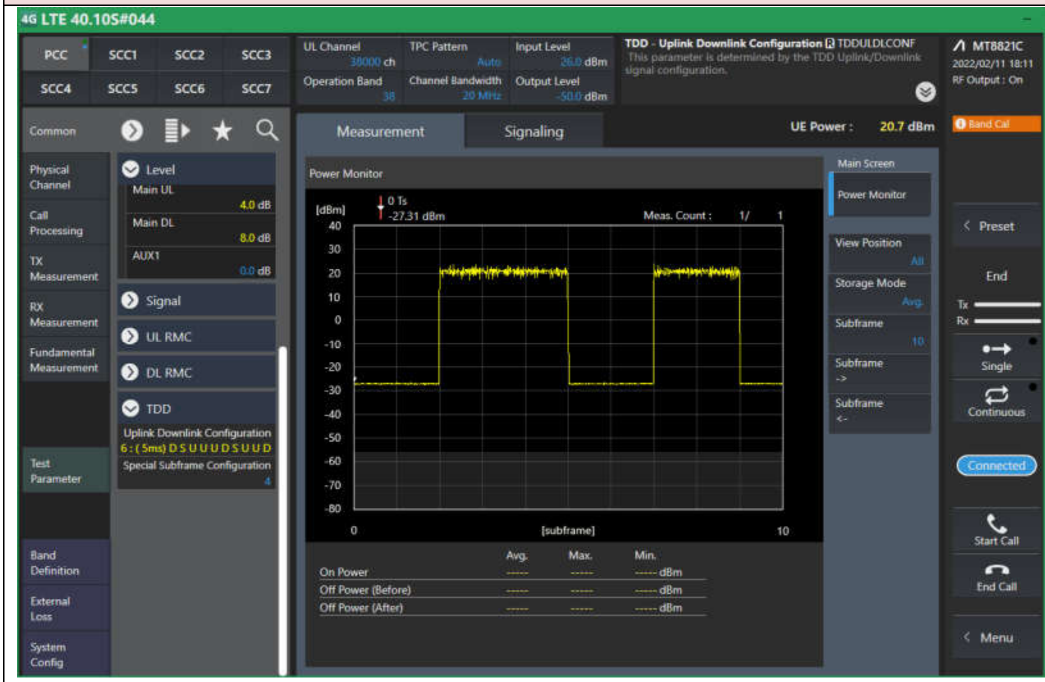


40%< K4 ≤50% (Config1)	P_{cmax} (Meas.)(dBm)	21.70	UL duty cycle (Meas.)	41.43%~43.33%

Set UL duty cycle=41.43% (uplink-downlink configuration 1 and special subframe configuration 4), P_{max} = 23.00 (dBm) and P_{SAR} = 2.50 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} – P_{offset}@k4, 0) = 23.00-Max(2.50-1.5,0) = 22.00 (dBm) , P_{cmax}(meas.)=21.70 (dBm).



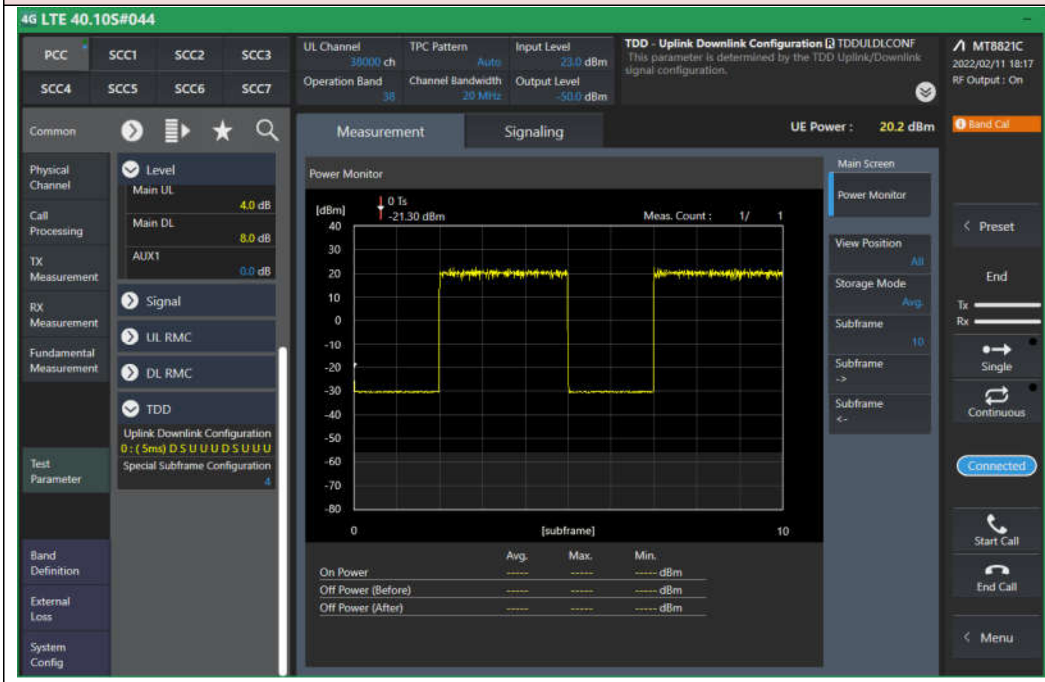
50%< K5 ≤60% (Config6)	P_{cmax} (Meas.)(dBm)	20.70	UL duty cycle (Meas.)	51.43%~53.33%
Set UL duty cycle=51.43% (uplink-downlink configuration 6 and special subframe configuration 4), P_{max} = 23.00 (dBm) and P_{SAR} = 2.50 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} – P_{offset}@k5, 0) = 23.00-Max(2.50-0.5,0) = 21.00 (dBm) , P_{cmax}(meas.)=20.70 (dBm).				



60%< K6 ≤63.3% (Config0)	P_{cmax}(Meas.)(dBm)	20.20	UL duty cycle (Meas.)	61.43%~63.33%

Set UL duty cycle=61.43% (uplink-downlink configuration 0 and special subframe configuration 4), P_{max} = 23.00 (dBm) and P_{SAR} = 2.50 (dB), then P_{cmax} = P_{max} – Max(P_{SAR} – P_{offset}@k6, 0) = 23.00-Max(2.50-0,0) = 20.50 (dBm) , P_{cmax}(meas.)=20.20 (dBm).

SAR testing is performed at P_{cmax}(meas.), and the measurement SAR(P_{cmax} meas.= 20.20 dBm) will be extended to report SAR(P_{cmax} tune up=20.50 dBm).



Duty cycle = (30720Ts*Ups+Uplink Component*Specials)/ (307200Ts)

Uplink Component=UpPTS

Duty cycle = [(30720Ts*Ups) + UpPTS *Specials]/ (307200Ts)

Different Duty cycles under different configurations:

Uplink-Downlink configuration	Subframe number			Configuration of special subframe							
				Normal cyclice prefix in downlink				Extended cyclice prefix in downlink			
				Normal cyclice prefix in uplink		Extended cyclice prefix in uplink		Normal cyclice prefix in uplink		Extended cyclice prefix in uplink	
	D	S	U	configuration 0~4	configuration 5~9	configuration 0~4	configuration 5~9	configuration 0~3	configuration 4~7	configuration 0~3	configuration 4~7
0	2	2	6	61.43%	62.85%	61.67%	**63.33%**	61.43%	62.85%	61.67%	**63.33%**
1	4	2	4	41.43%	42.85%	41.67%	43.33%	41.43%	42.85%	41.67%	43.33%
2	6	2	2	21.43%	22.85%	21.67%	23.33%	21.43%	22.85%	21.67%	23.33%
3	6	1	3	30.71%	31.43%	30.83%	31.67%	30.71%	31.43%	30.83%	31.67%
4	7	1	2	20.71%	21.43%	20.83%	21.67%	20.71%	21.43%	20.83%	21.67%
5	8	1	1	10.71%	11.43%	10.83%	11.67%	10.71%	11.43%	10.83%	11.67%
6	3	2	5	51.43%	52.85%	51.67%	53.33%	51.43%	52.85%	51.67%	53.33%

Note: FDD LTE does not support UL duty cycle detection mechanism.

ANNEX L: Accreditation Certificate

United States Department of Commerce
National Institute of Standards and Technology

NVLAP® ilac-MRA

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 600118-0

Telecommunication Technology Labs, CAICT
Beijing
China

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2020-09-29 through 2021-09-30
Effective Dates

For the National Voluntary Laboratory Accreditation Program

*****END OF REPORT*****