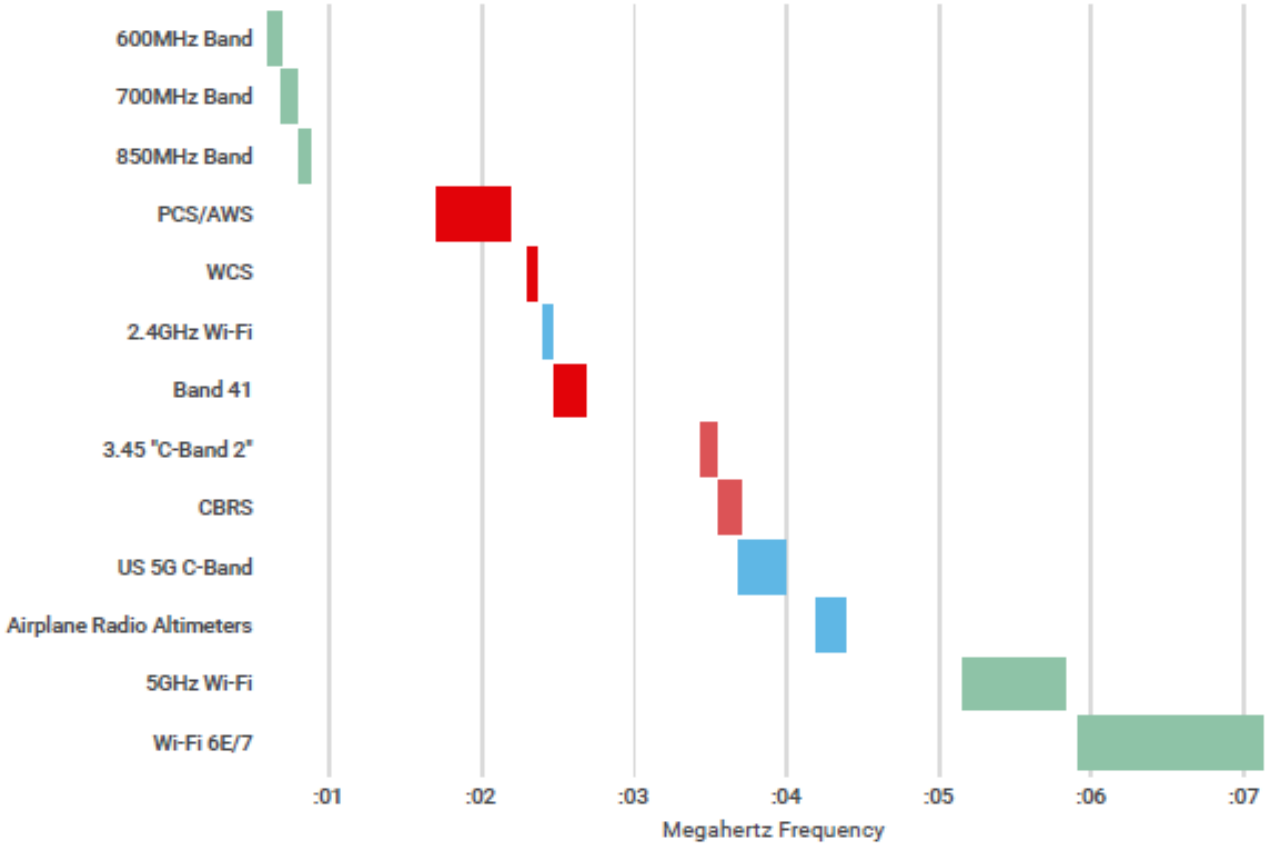
5G C-Band Interference Mitigation Solutions

Edward Liang, PhD, MCV Microwave East, Inc.

MICROWAVE

IMS
Connecting Minds. Exchanging Ideas.

Common US Spectrum Bands

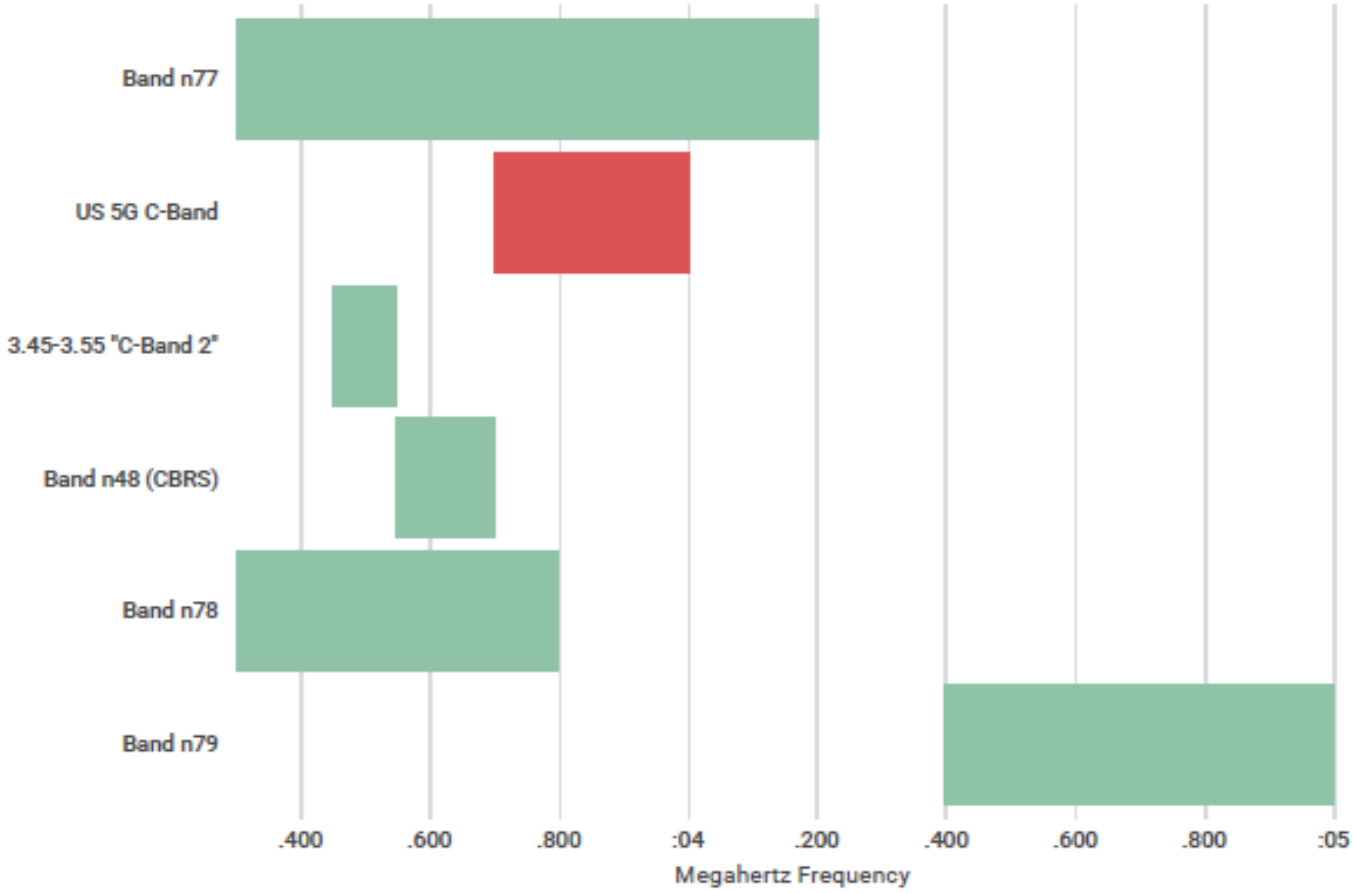


(The chart above shows the primary wireless carrier user of each band; it does not include minor users)

MCV MICROWAVE

IMS Connecting Minds. Exchanging Ideas.

C-Band Classes



3.3-4.2GHz

3.7-3.98GHz

3.45-3.55GHz

3.55-3.7GHz

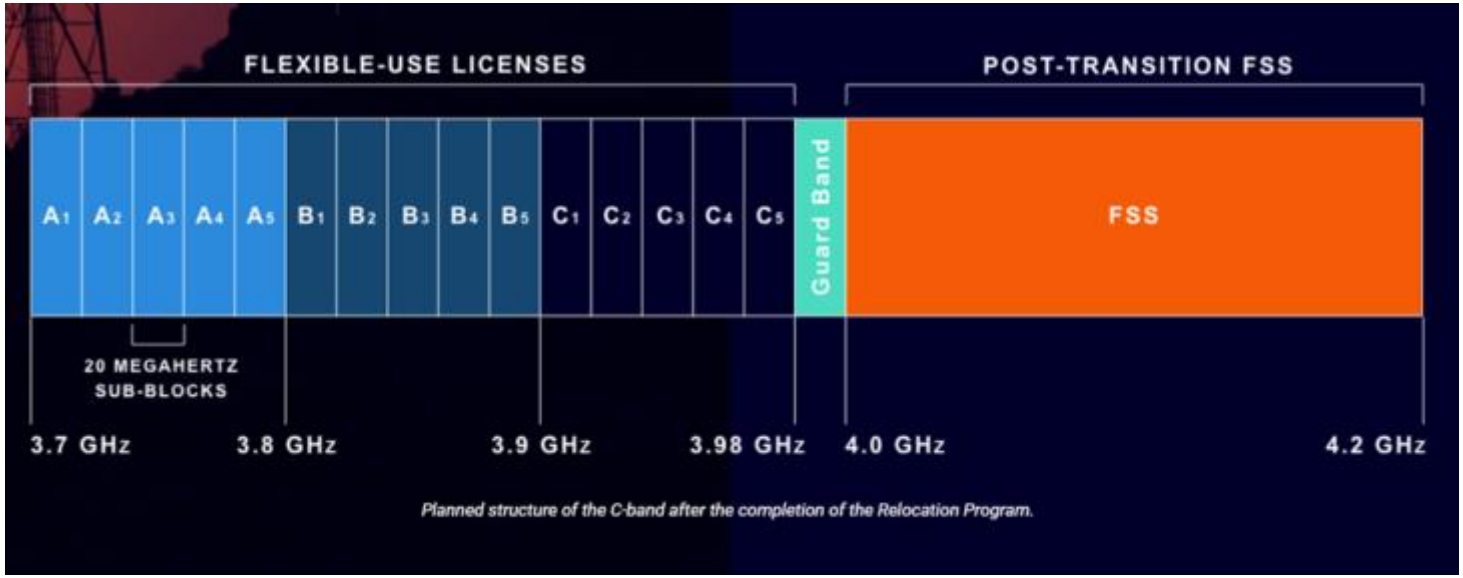
3.3-3.8GHz

4.4-5.0GHz

MCV MICROWAVE

IMS Connecting Minds. Exchanging Ideas.

C-Band Satellite Earth Station



The new 5G cellular network operates at 3.3 to 3.6 GHz poses interference concerns with the C-band satellite communication terminals which receive Space-to-Earth signals in the 3.4 to 4.2 GHz band and transmit signals in the range of 5.85 GHz to 6.425 GHz. It can also interfere with radio altimeters operate between 4.2-4.4GHz. In the case of Satcom, the interference-mitigating LNB does not completely eliminate the interference problem and some additional filtering before the LNB may be required. This paper presents McV RED and BLUE filter solutions which successfully suppress all spurious signals for Satcom receive and transmit frequencies.

MCV MICROWAVE

IMS Connecting Minds. Exchanging Ideas.

C-BAND EARTH STATIONS 5G FILTERS SPECIFICATIONS

The specifications for C-band satellite earth stations filters are used to prevent harmful interference from 5G signals included in the FCC Report and Order of Proposed Modification (FCC 20-22) in the matter of "Expanding Flexible Use of the 3.7 to 4.2 GHz Band" (adopted February 28, 2020). The filter rejection specifications contained in this document comply with the filter mask requirements in the FCC Report and Order.

MCV MICROWAVE

IMS Connecting Minds. Exchanging Ideas.

100+20 MHz "Red" Filter		
Electrical Characteristics	Passband	3820 - 4200 MHz
	Group delay variation within +/- 0.5 MHz	1.45 nSec max
	Insertion Loss in Pass Band	1.3 dB max
	Return Loss	20 dB min
	Rejection from 3700 MHz to 3720 MHz	70 dB min
	Rejection from 3720 MHz to 3800 MHz	60 dB min
	Rejection from 3800 MHz to 3805 MHz	30 dB min
	Rejection from 3805 MHz to 3820 MHz	0 dB min
	Rejection above 4230 MHz	25 dB min
Mechanical Characteristics	Interfaces	CPR-229G & CPR-229F Through holes both ends
	Size (L x W x H) Length inclusive of flanges Width and height exclusive of flanges Width and height inclusive of flanges	 6.75" x 3.00" x 2.00" 6.75" x 3.00" x 2.96"
	Operating Temperature	-40° C to +50° C
	Finish	Matte white light textured paint

MCV MICROWAVE

IMS Connecting Minds. Exchanging Ideas.

McV RED

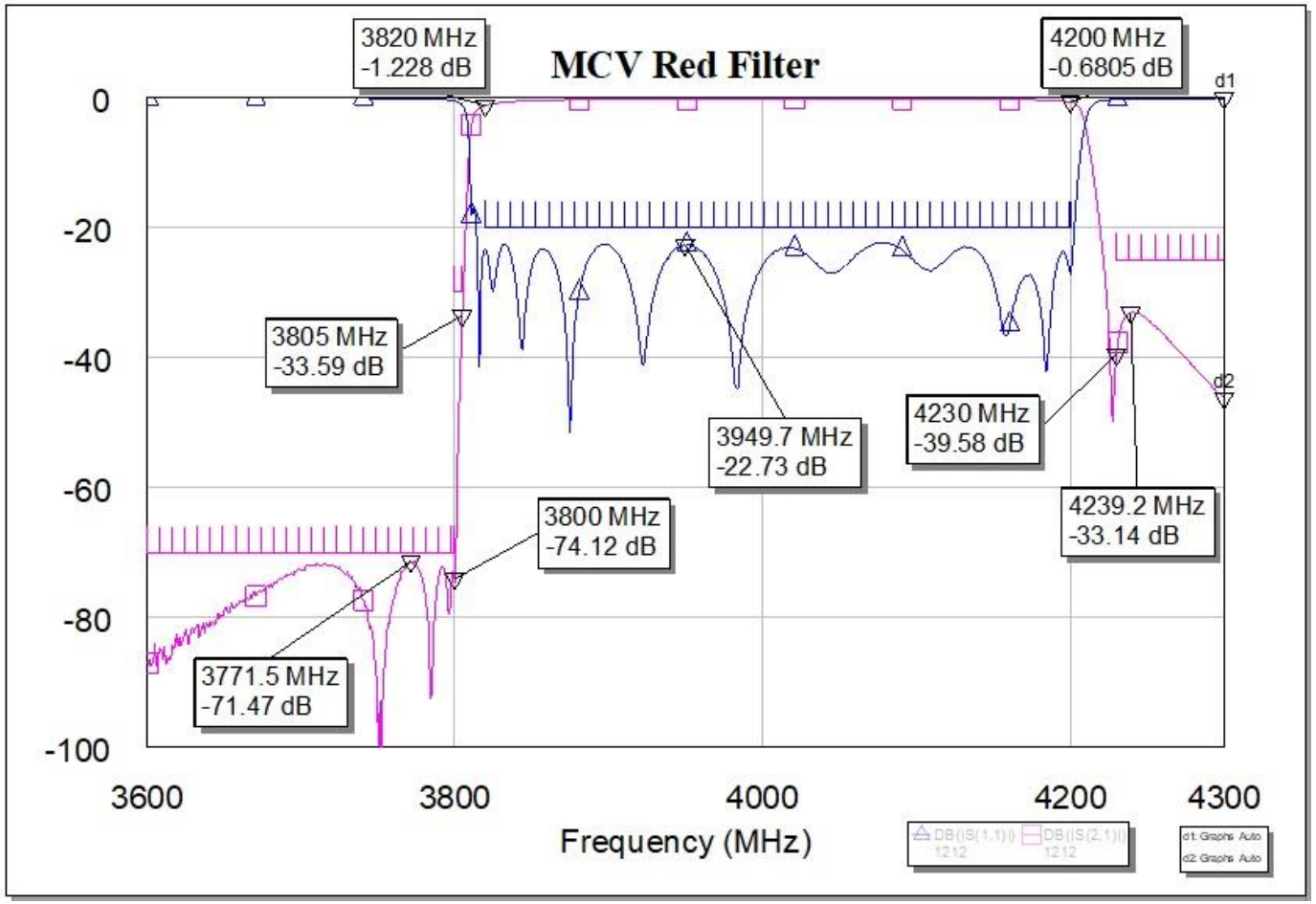
Electrical Specifications

PASSBAND	3820 – 4200 MHz
PASSBAND INSERTION LOSS	1.3 dB Max.
PASSBAND RETURN LOSS	18 dB Min.
REJECTION	
3700 – 3800 MHz	70 dB Min.
3800 – 3805 MHz	30 dB Min.
4230 – 5000 MHz	25 dB Min.
5000 – 6450 MHz	40 dB Min.
Group Delay Variation	2nS Max. over any 1 MHz Band
Power Handling	100 W Avg.

MCV MICROWAVE

IMS Connecting Minds. Exchanging Ideas.

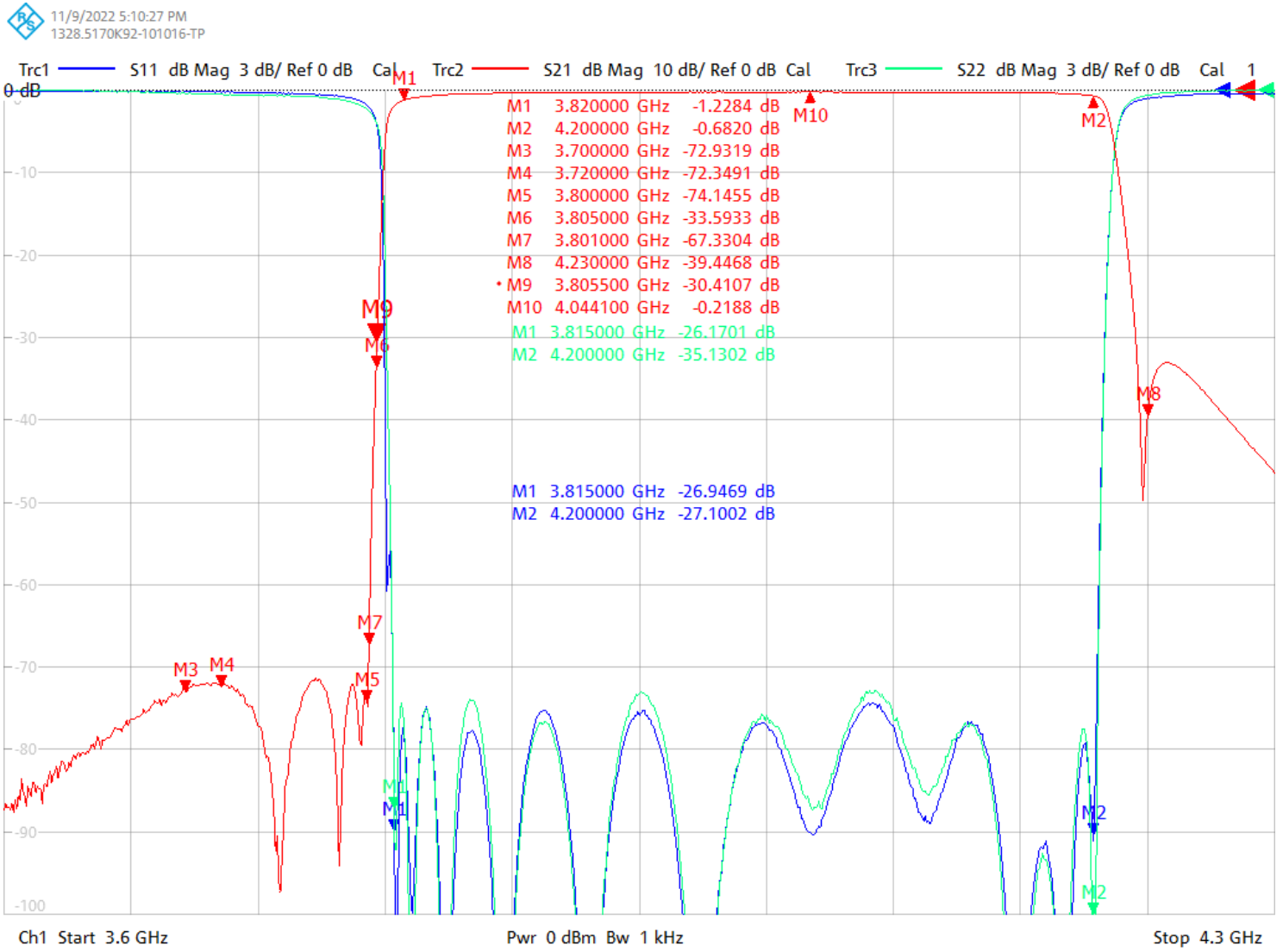
McV RED



MICROWAVE

IMS
Connecting Minds. Exchanging Ideas.

McV RED


11/9/2022 5:10:27 PM
1328.5170K92-101016-TP
Trc1 S11 dB Mag 3 dB/ Ref 0 dB Cal
Trc2 S21 dB Mag 10 dB/ Ref 0 dB Cal
Trc3 S22 dB Mag 3 dB/ Ref 0 dB Cal 1
0 dB
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
M1 3.820000 GHz -1.2284 dB
M2 4.200000 GHz -0.6820 dB
M3 3.700000 GHz -72.9319 dB
M4 3.720000 GHz -72.3491 dB
M5 3.800000 GHz -74.1455 dB
M6 3.805000 GHz -33.5933 dB
M7 3.801000 GHz -67.3304 dB
M8 4.230000 GHz -39.4468 dB
• M9 3.805500 GHz -30.4107 dB
M10 4.044100 GHz -0.2188 dB
M1 3.815000 GHz -26.1701 dB
M2 4.200000 GHz -35.1302 dB
M1 3.815000 GHz -26.9469 dB
M2 4.200000 GHz -27.1002 dB
Ch1 Start 3.6 GHz
Pwr 0 dBm Bw 1 kHz
Stop 4.3 GHz

280+20 MHz "Blue" Filter		
Electrical Characteristics	Passband	4000 - 4200 MHz
	Group delay variation within +/- 0.5 MHz	1.45 nSec max
	Insertion Loss in Pass Band	1.3 dB max
	Return Loss	20 dB min
	Rejection from 3700 MHz to 3900 MHz	70 dB min
	Rejection from 3900 MHz to 3980 MHz	60 dB min
	Rejection from 3980 MHz to 3985 MHz	30 dB min
	Rejection from 3985 MHz to 4000 MHz	0 dB min
	Rejection above 4230 MHz	25 dB min
Mechanical Characteristics	Interfaces	CPR-229G & CPR-229F Through holes both ends
	Size (L x W x H) Length inclusive of flanges Width and height exclusive of flanges Width and height inclusive of flanges	 6.75" x 3.00" x 2.00" 6.75" x 3.00" x 2.96"
	Operating Temperature	-40° C to +50° C
	Finish	Matte white light textured paint

MCV MICROWAVE

IMS Connecting Minds. Exchanging Ideas.

McV BLUE

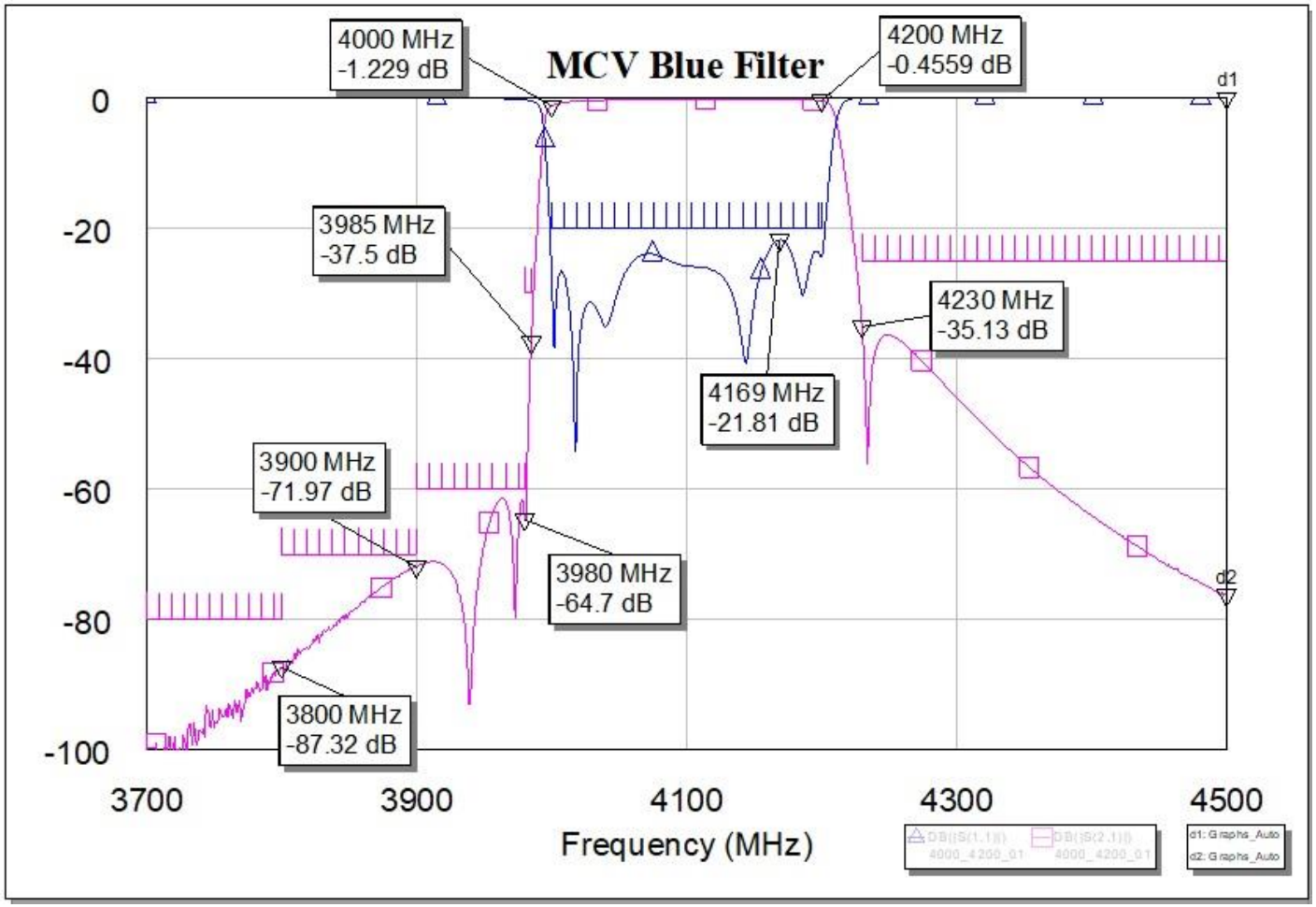
Electrical Specifications

PASSBAND	4000 – 4200 MHz
PASSBAND INSERTION LOSS	1.3 dB Max. (25 ± 5° C); 1.4 dB Max.
PASSBAND RETURN LOSS	18 dB Min.
REJECTION	
3720 – 3800 MHz	80 dB Min.
3800 – 3900 MHz	70 dB Min.
3900 – 3980 MHz	60 dB Min.
3980 – 3985 MHz	30 dB Min.
4230 – 5000 MHz	25 dB Min.
5000 – 6425 MHz	40 dB Min.
Power Handling	100 W Avg
Group Delay Variation	2nS Max. over any 1 MHz Band

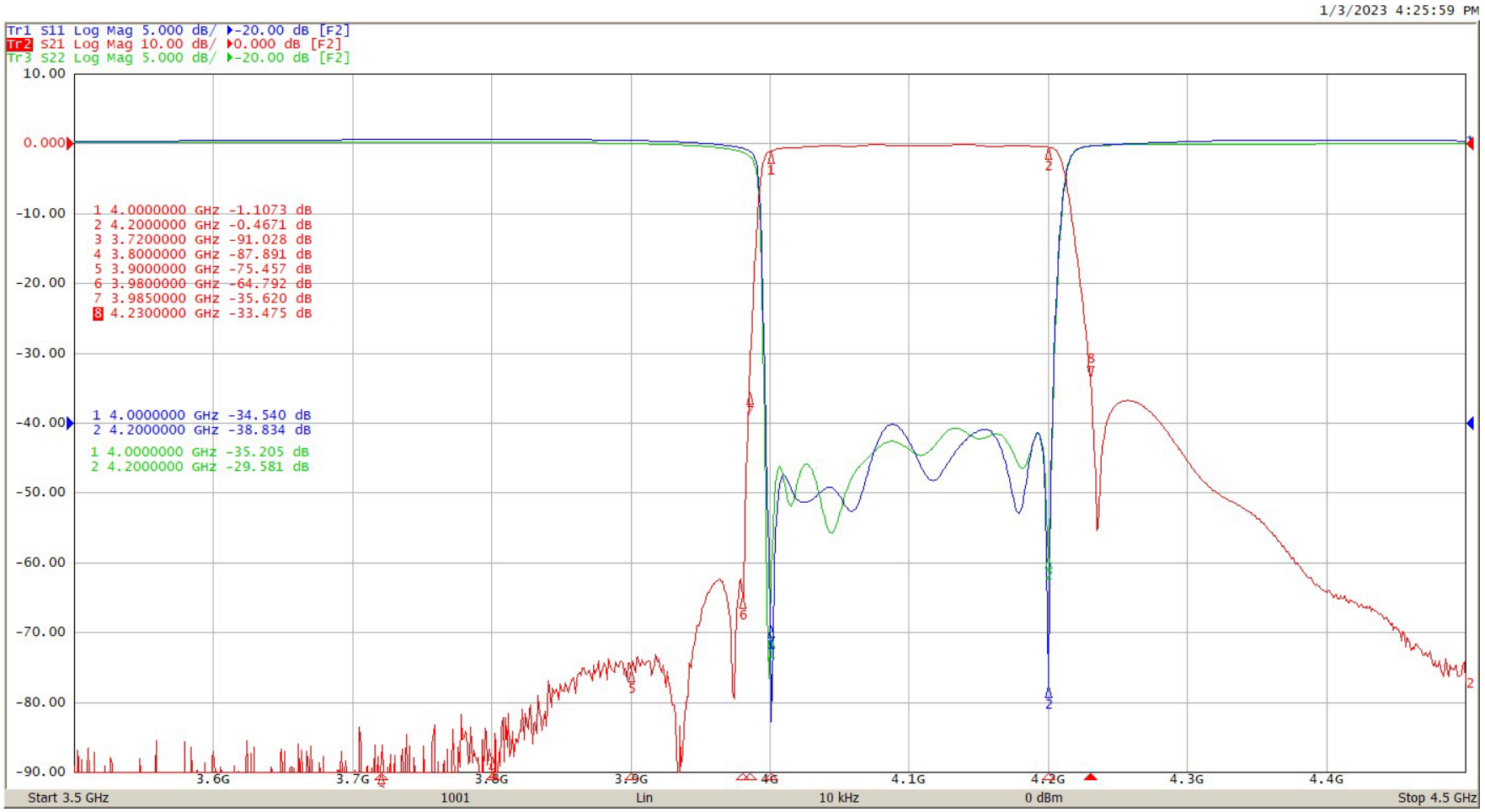
MCV MICROWAVE

IMS Connecting Minds. Exchanging Ideas.

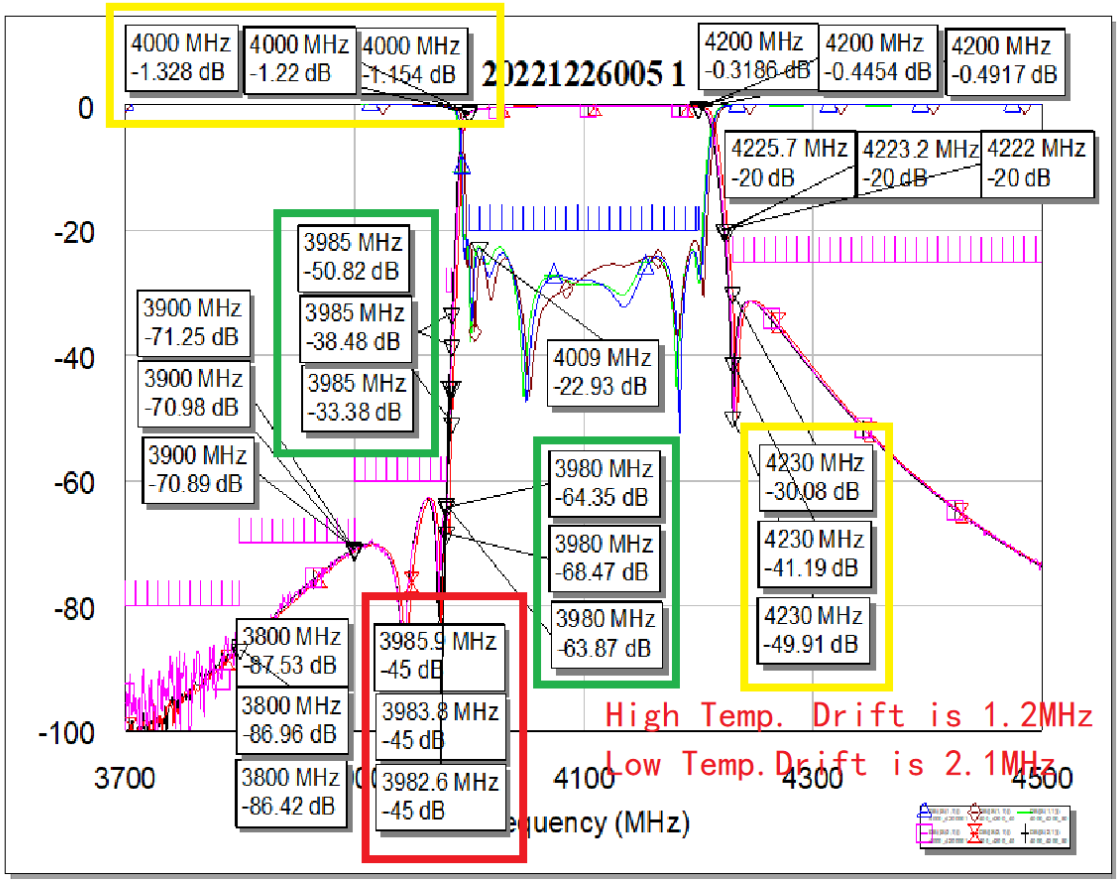
McV BLUE


MCV Blue Filter
4000 MHz
-1.229 dB
4200 MHz
-0.4559 dB
3985 MHz
-37.5 dB
4230 MHz
-35.13 dB
4169 MHz
-21.81 dB
3900 MHz
-71.97 dB
3980 MHz
-64.7 dB
3800 MHz
-87.32 dB
0
-20
-40
-60
-80
-100
3700
3900
4100
4300
4500
Frequency (MHz)
d1
d2

McV BLUE


1/3/2023 4:25:59 PM
Tr1 S11 Log Mag 5.000 dB/ -20.00 dB [F2]
Tr2 S21 Log Mag 10.00 dB/ 0.000 dB [F2]
Tr3 S22 Log Mag 5.000 dB/ -20.00 dB [F2]
1 4.0000000 GHz -1.1073 dB
2 4.2000000 GHz -0.4671 dB
3 3.7200000 GHz -91.028 dB
4 3.8000000 GHz -87.891 dB
5 3.9000000 GHz -75.457 dB
6 3.9800000 GHz -64.792 dB
7 3.9850000 GHz -35.620 dB
8 4.2300000 GHz -33.475 dB
1 4.0000000 GHz -34.540 dB
2 4.2000000 GHz -38.834 dB
1 4.0000000 GHz -35.205 dB
2 4.2000000 GHz -29.581 dB
Start 3.5 GHz
1001
Lin
10 kHz
0 dBm
Stop 4.5 GHz

McV BLUE


4000 MHz
-1.328 dB
4000 MHz
-1.22 dB
4000 MHz
-1.154 dB
20221226005 1
4200 MHz
-0.3186 dB
4200 MHz
-0.4454 dB
4200 MHz
-0.4917 dB
4225.7 MHz
-20 dB
4223.2 MHz
-20 dB
4222 MHz
-20 dB
3985 MHz
-50.82 dB
3985 MHz
-38.48 dB
3985 MHz
-33.38 dB
3900 MHz
-71.25 dB
3900 MHz
-70.98 dB
3900 MHz
-70.89 dB
4009 MHz
-22.93 dB
3980 MHz
-64.35 dB
3980 MHz
-68.47 dB
3980 MHz
-63.87 dB
4230 MHz
-30.08 dB
4230 MHz
-41.19 dB
4230 MHz
-49.91 dB
3800 MHz
-87.53 dB
3800 MHz
-86.96 dB
3800 MHz
-86.42 dB
3985.9 MHz
-45 dB
3983.8 MHz
-45 dB
3982.6 MHz
-45 dB
High Temp. Drift is 1.2MHz
Low Temp. Drift is 2.1MHz
0
-20
-40
-60
-80
-100
3700
4100
4300
4500
quency (MHz)

3700-4200 MHz Bandpass Filter 1

Parameter	Unit	Specification
Center Frequency (Fc)	MHz	3950
Passband	MHz	3700 ~ 4200 min.
Passband Insertion Loss	dB	1.5 max. (excluding connectors)
Passband Return Loss	dB	17 min.
Rejection	dB	60 min @ 3500 MHz
		60 min @ 3600 MHz
		60 min @ 3670 MHz
		60 min @ 3680 MHz
		30 min @ 4230 MHz
		40 min @ 4250 MHz
Group Delay	ns	16 max. within ± 5 MHz
Average Power	W	100 max.
In / Out Impedance	Ohms	50
In / Out connection	-	CPR-229G / CPR-229F
Operating Temperature Range	°C	-40 to +65
Dimensions (including flanges)	mm	130.0 x 98.4 x 69.9 (L x W x H)
Weight	kg	0.85
External Finish	-	White
Sealing (mated)	-	IP66
RoHS	-	Yes

MCV MICROWAVE

IMS Connecting Minds. Exchanging Ideas.

3700-4200 MHz Bandpass Filter 2

Parameter	Unit	Specification
Center Frequency (Fc)	MHz	3950
Passband	MHz	3700 ~ 4200 min.
Passband Insertion Loss	dB	0.5 max. (including connectors)
Passband Ripple	dB	0.2 max.
Passband Return Loss	dB	18 min.
Rejection	dB	75 min @ 3400 to 3500 MHz
		70 min @ 3500 to 3600 MHz
		75 min @ 5800 to 6500 MHz
Group Delay	ns	8 max.
Average Power	W	100 max.
In / Out connection	-	CPR-229G / CPR-229F
Operating Temperature Range	°C	-40 to +65
Dimensions (including flanges)	mm	120.0 x 98.4 x 69.9 (L x W x H)
Weight	kg	0.7
External Finish	-	White
Sealing (mated)	-	IP66
RoHS	-	Yes

MCV MICROWAVE

IMS Connecting Minds. Exchanging Ideas.

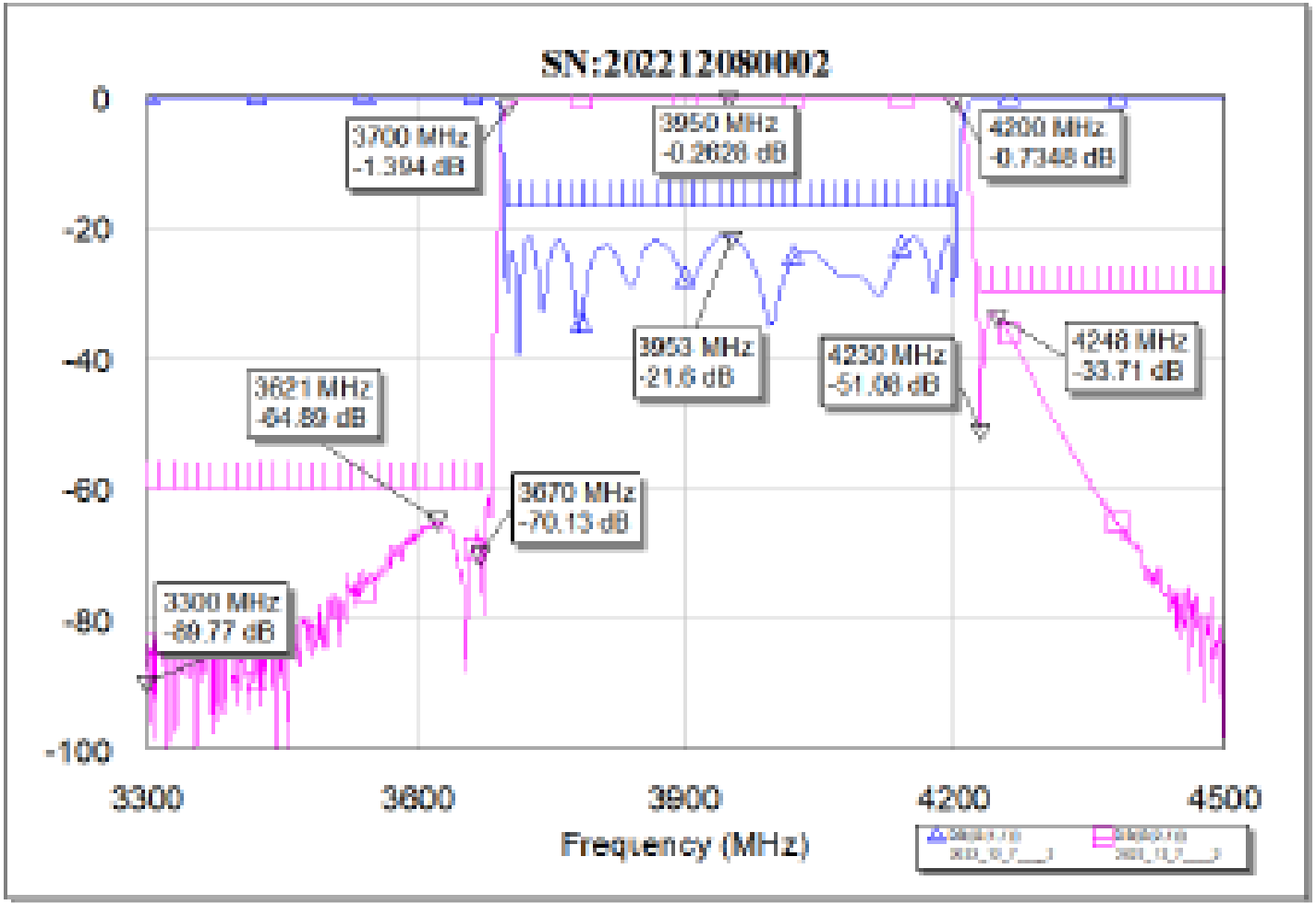
3700-4200 MHz Bandpass Filter 3

Parameter	Unit	Specification
Center Frequency (Fc)	MHz	3950
Passband	MHz	3700 ~ 4200 min.
Passband Insertion Loss	dB	0.5 max. @3950 MHz; 1.5 max @3700 & 4200 MHz
Passband Return Loss	dB	17 min.
Rejection	dB	60 min @ 3300 to 3670 MHz 30 min @ 4230 MHz and higher
Group Delay Variation within ±0.5MHz	ns	3 max.
Average Power	W	100 max.
In / Out connection	-	CPR-229G / CPR-229F
Operating Temperature Range	°C	-30 to +60
Dimensions (including flanges)	mm	160 x 99 x 70.5 (L x W x H)
Weight	kg	1.0 max.
External Finish	-	White
Sealing (mated)	-	IP67
RoHS	-	Yes

MCV MICROWAVE

IMS Connecting Minds. Exchanging Ideas.

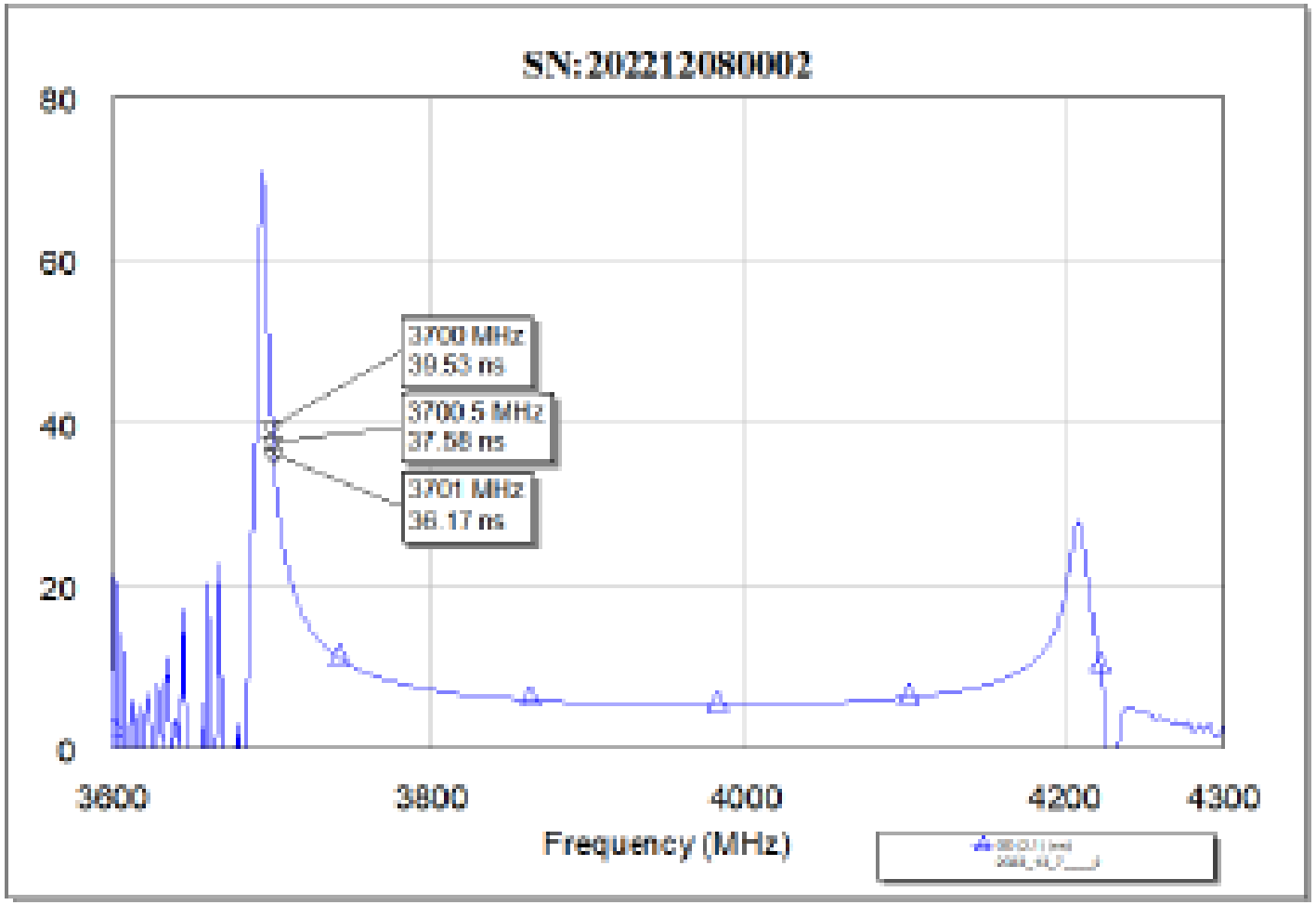
3700-4200 MHz Bandpass Filter 3



MICROWAVE

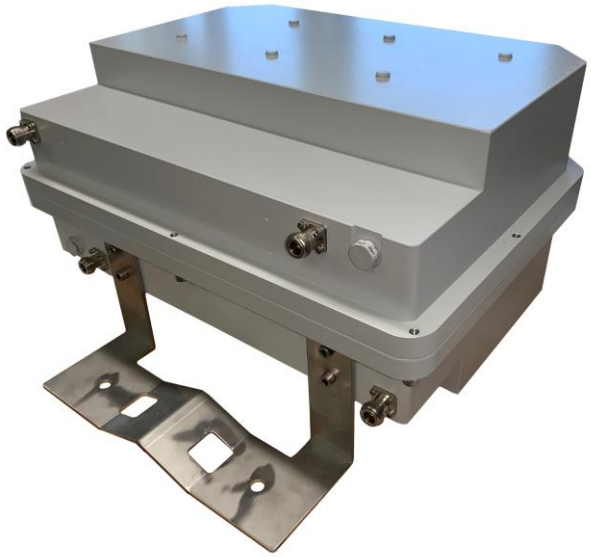
IMS
Connecting Minds. Exchanging Ideas.

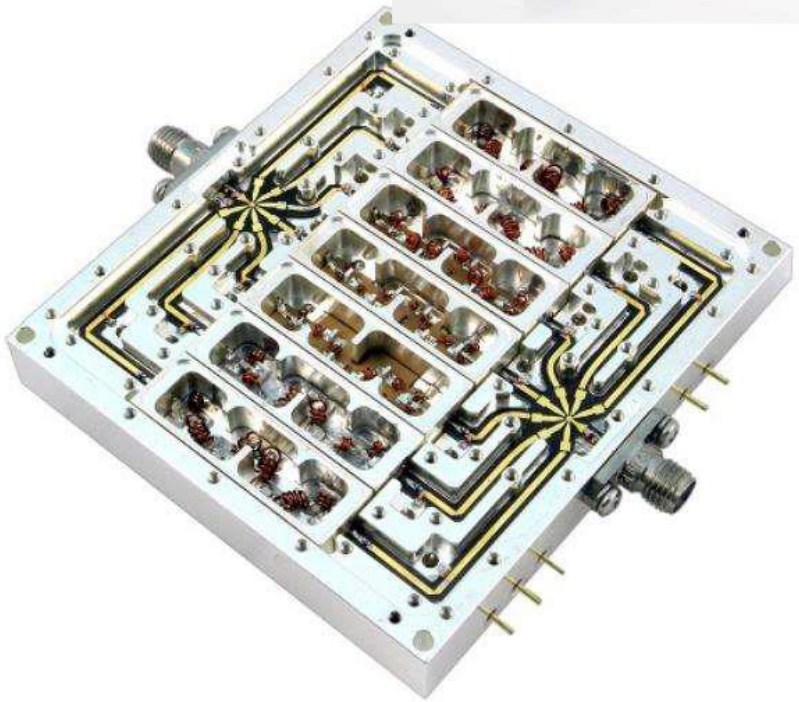
3700-4200 MHz Bandpass Filter 3

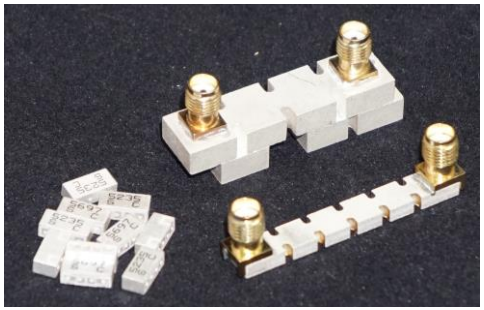


MICROWAVE

IMS
Connecting Minds. Exchanging Ideas.







MICROWAVE

MCV MICROWAVE

- MATERIALS
- CUSTOMER CENTRIC
- VERTICALLY INTEGRATED

Discover how our materials expertise, customized solutions, and state-of-the-art US manufacturing and testing facility, can meet your RF microwave materials and filters requirements.