

# FM Transmission System Measurements

**K284CV 104.7 MHz**  
**K289CF 105.7 MHz**

**Whitefish MT**  
**Kalispell MT**

**07/31/2020**

## Measurement method

K294CV and K289CF share a common Nicom BKG77/2M antenna fed by a branch combiner. Measurements were performed on the combined output to demonstrate compliance with 73.317(d)

*Any emission appearing on a frequency removed from the carrier by more than 600 kHz must be attenuated at least  $43 + 10 \text{ Log}_{10}$  (Power, in watts) dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.*

An RF sample was obtained from a Shively Model 5821-E Directional Coupler installed in the transmission line at the output of the combiner. The coupling factor of the 5821-E coupler was measured at the fundamental, harmonic and likely spur frequencies. An Agilent Agilent N9340B Spectrum analyzer with tracking generator was used for these measurements.

Harmonic measurements were performed using an Agilent N9340B analyzer, switched attenuator and three Mini-Circuits NHP-175 Filters. The frequency response of the filters were measured and documented. The filters provide substantial reduction of the fundamental, while passing frequencies above the filter's cutoff with little attenuation.

The sample from the directional coupler was connected to the analyzer via a switched attenuator . The attenuation was adjusted to obtain a reference before the filters were connected in line.

The magnitude of the measured harmonics were then tabulated after correcting for the directional coupler, high pass filter.

Inter modulation products measurements were performed using the N9340B analyzer and a sample from the directional coupler connected to the analyzer via a switched attenuator . The attenuation was adjusted to obtain as high a reference level as possible without overload of the analyzer. The magnitude of the measured IM products were tabulated after correcting for the directional coupler response.

No other emissions related to the operation of K284CV and K289CF were observed. Measurements were performed in the absence of modulation.

*All measured emissions with both K284CV and K289CF operating fall below -77.82dB of carrier indicating that both stations comply with 73.317(d)*

## Equipment used

Shively	5821-E Directional coupler S/N 26407
Mini-circuits	NHP-175 High-Pass Filter (x3)
Agilent	N9340B Spectrum analyzer S/N CN03485821 Cal certification # N9340BCN03485821
Agilent	85032A Type-N Calibration Kit
KAY-Pentax	Model 837 Switchable 0-102dB 50R attenuator. S/N 33140-40

## Statement of personnel making measurements

Tony Mulligan states that he is a Contract Radio Engineer, resident in the State of Montana, doing business as Mulligan Technical Services with an address of P.O. Box 2566, Kalispell, MT.59903-2566.

That he has worked as a broadcast engineer since 1982

That he has been certified as a Radio Broadcast Engineer by the Society of Broadcast Engineers, Certification No: 3285

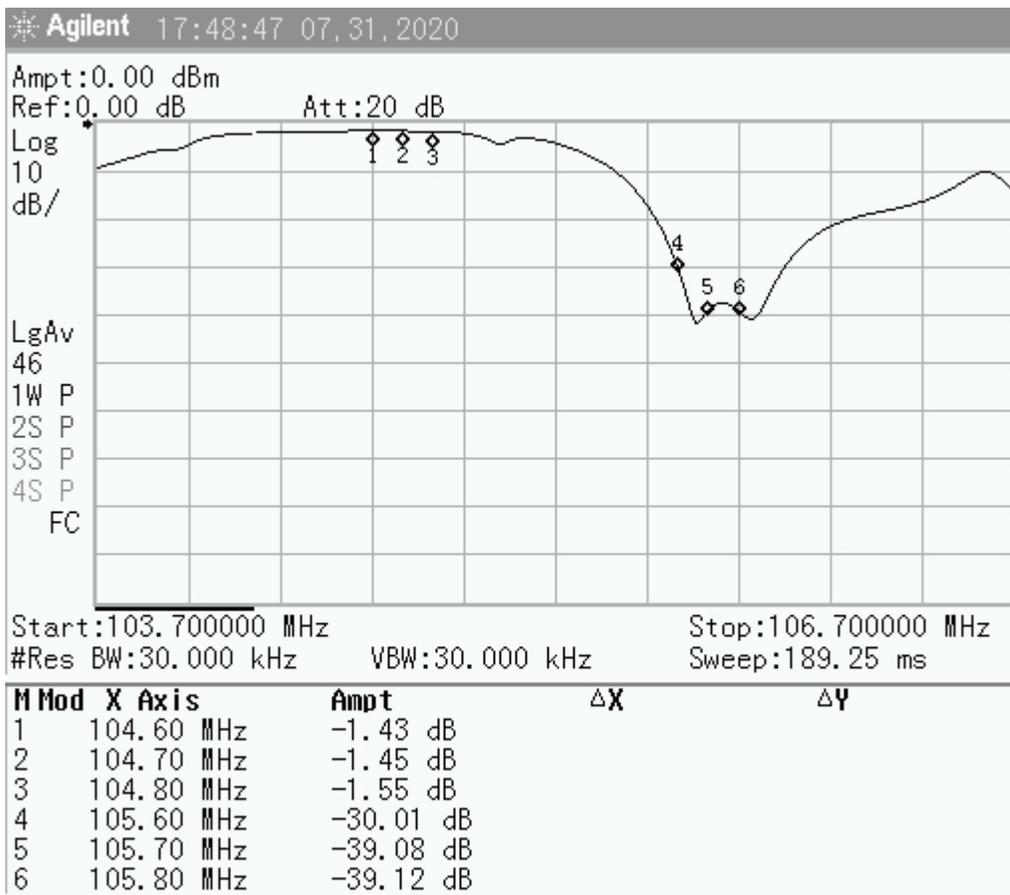
That the measurements, information and data presented was obtained or prepared by him personally or under his direct supervision and is accurate to his knowledge.

A handwritten signature in black ink that reads "Tony C. Mulligan". The signature is written in a cursive style with a long horizontal line extending to the left.

Tony C. Mulligan

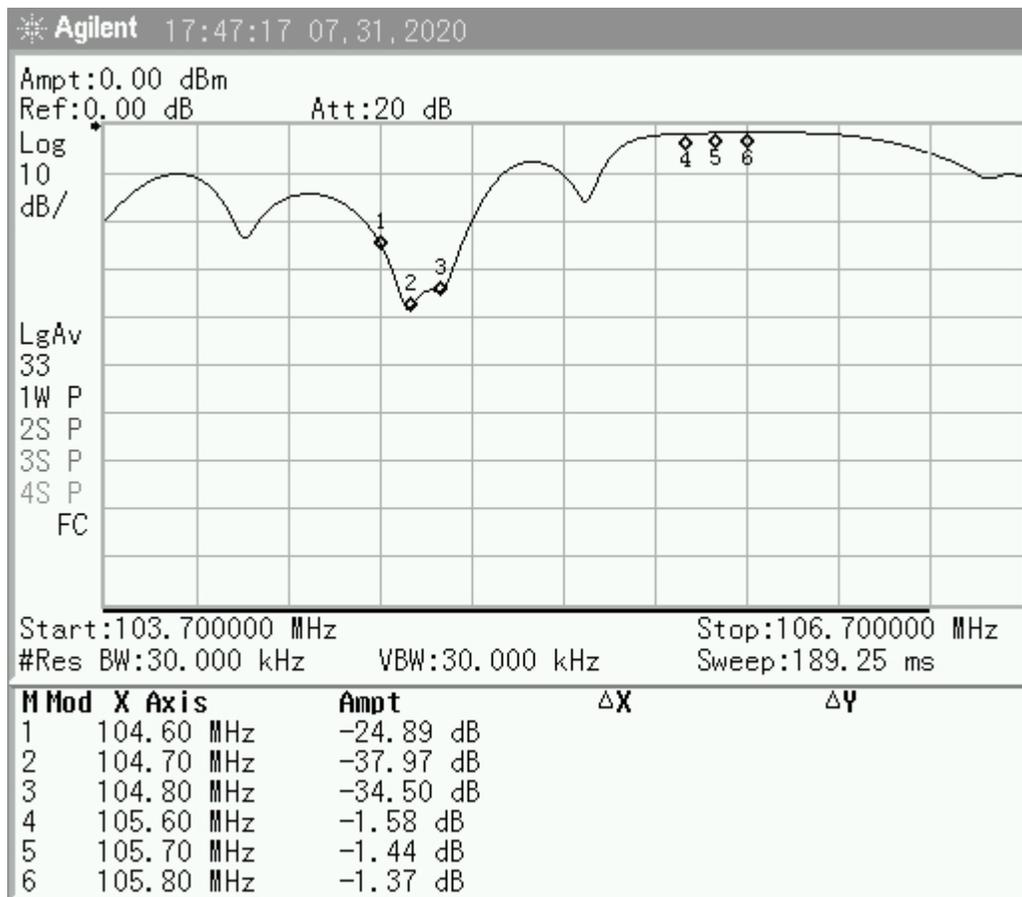
Date 07/31/2020

# Combiner insertion loss 104.7 MHz branch



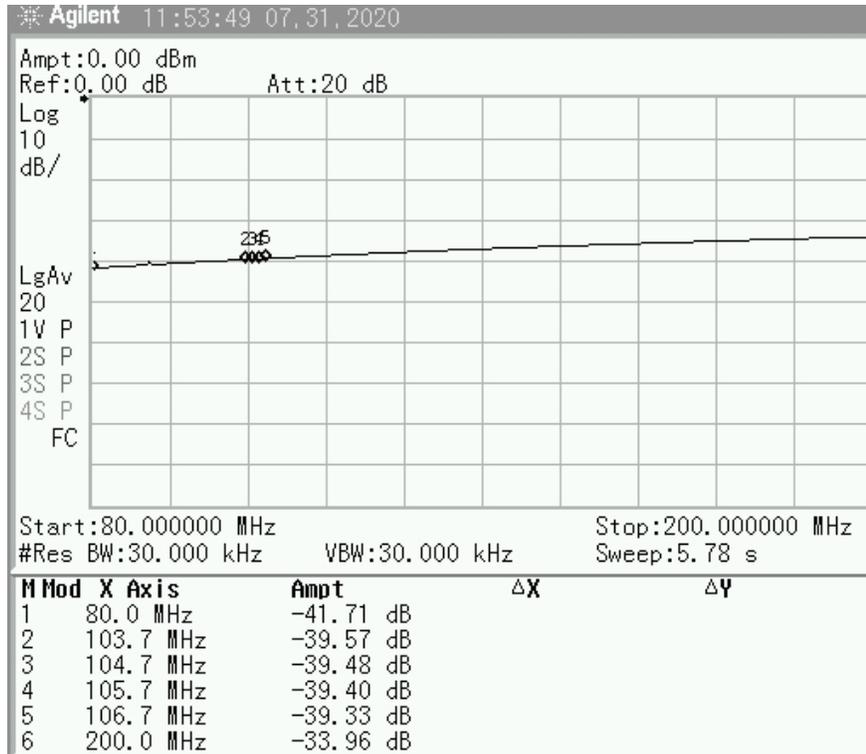
104.7 MHz      -1.45 dB

# Combiner insertion loss 105.7 MHz branch



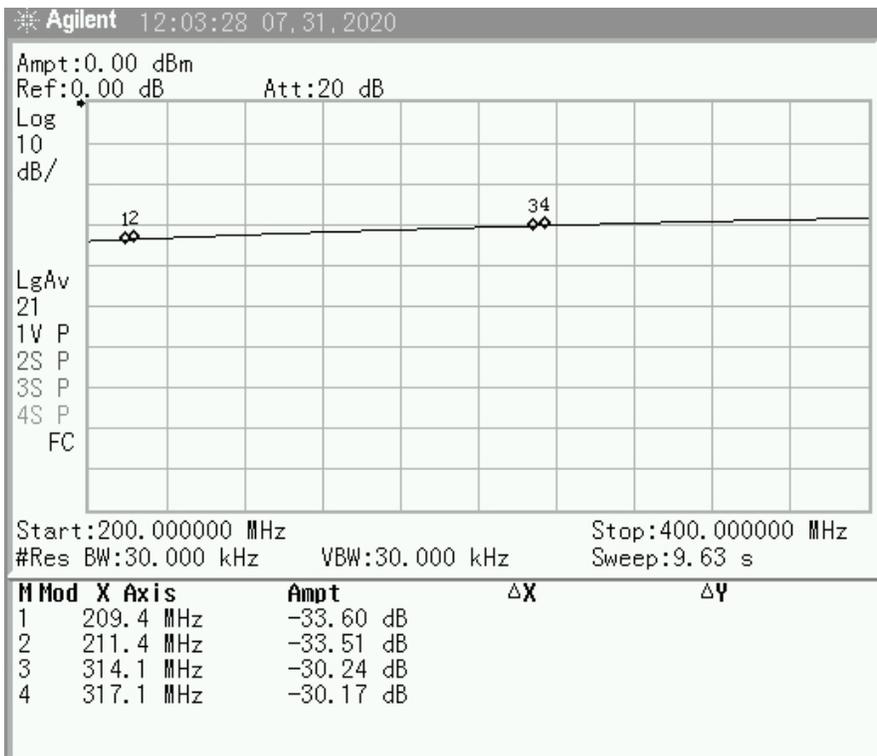
105.7 MHz      -1.44dB

# 5821-E Directional coupler

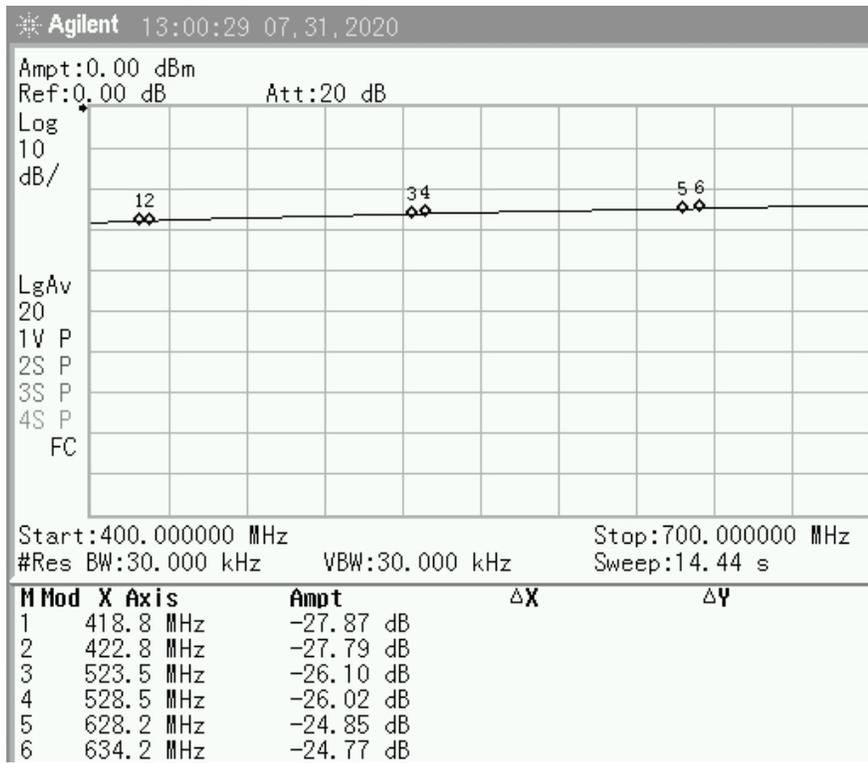


103.7 MHz            -39.57dB  
104.4 MHz            -39.48dB  
105.7 MHz            -39.40dB  
106.7 MHz            -39.33dB

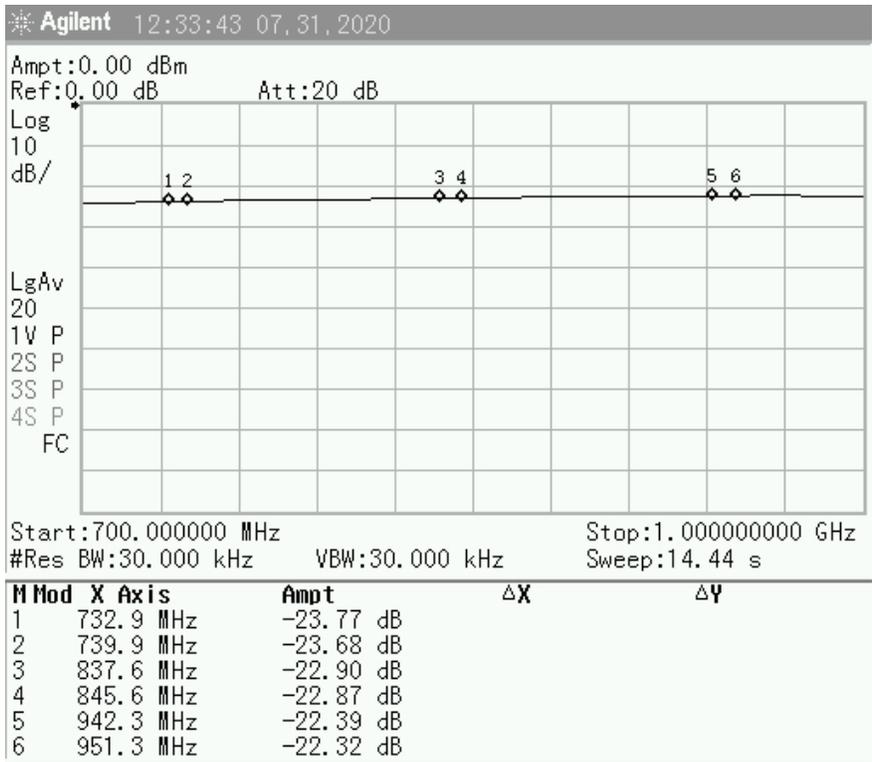
# 5821-E Directional coupler



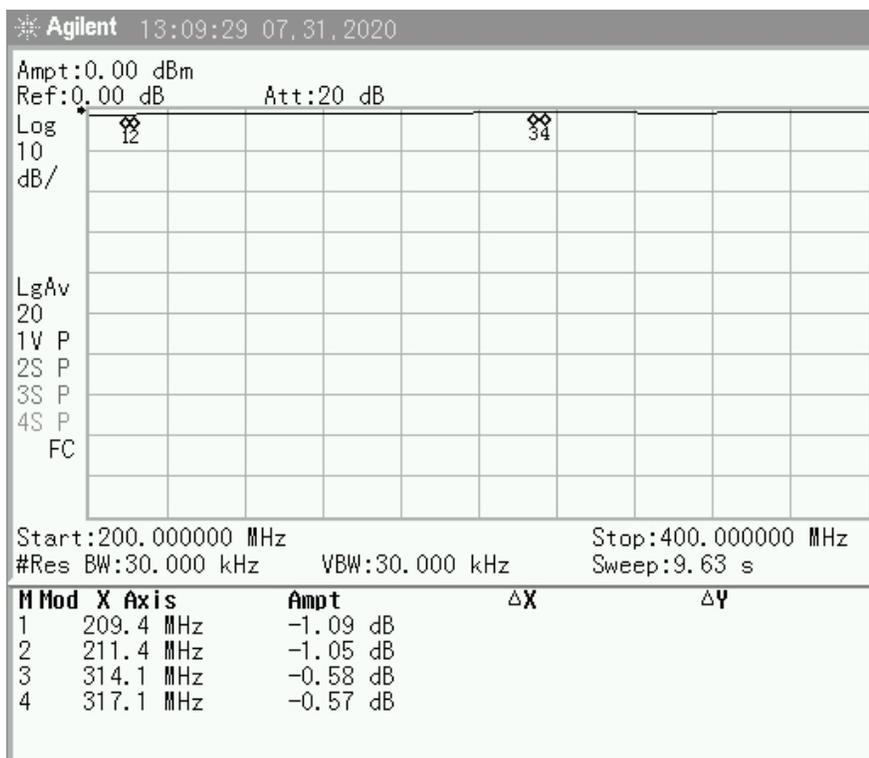
# 5821-E Directional coupler



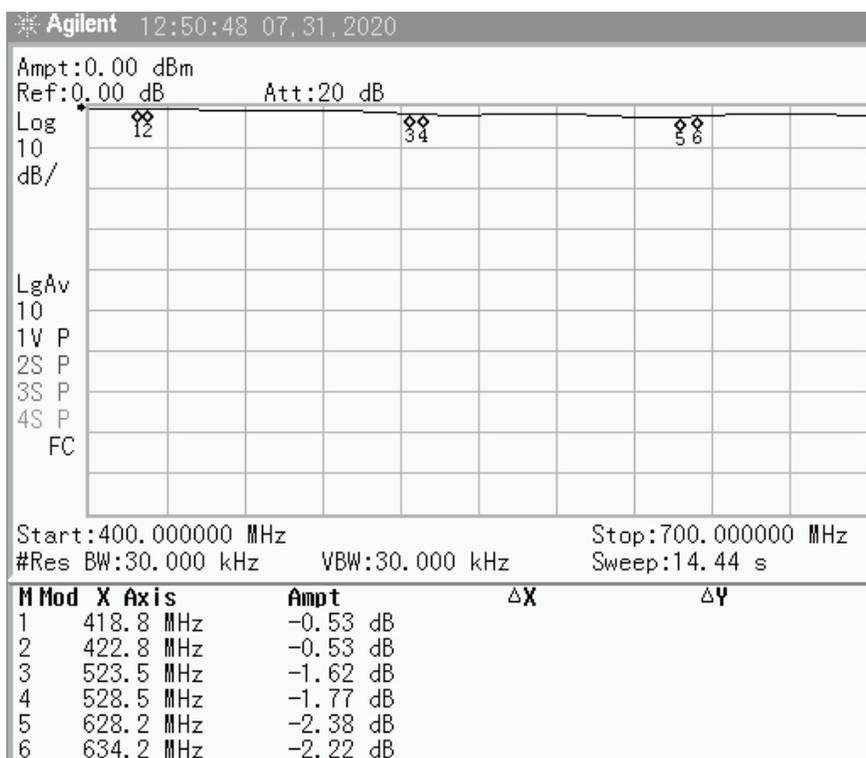
# 5821-E Directional coupler



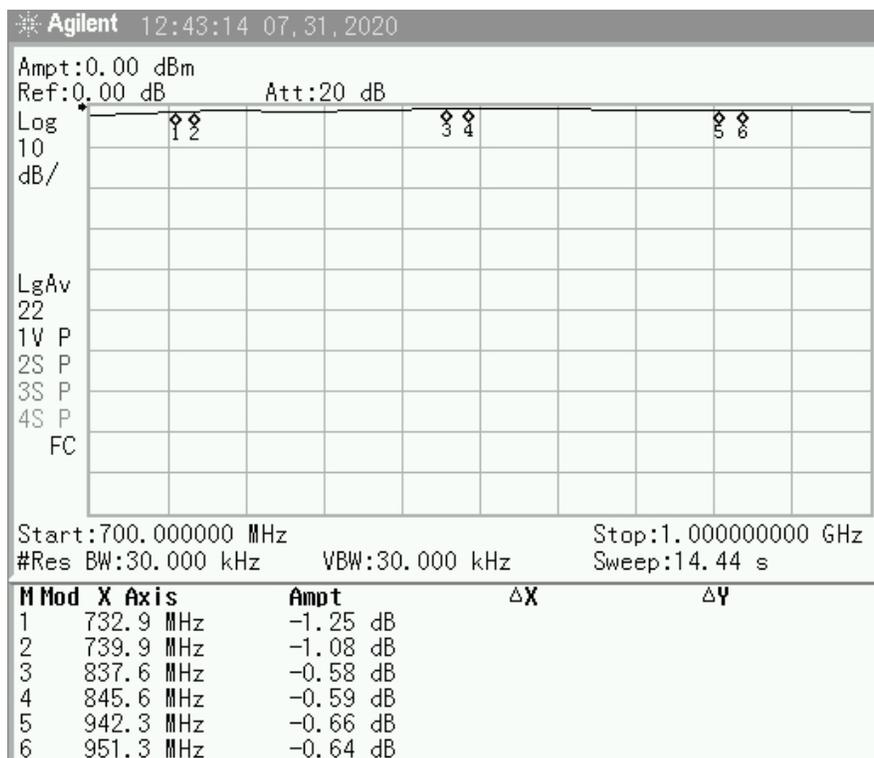
# Mini-Circuits NHP-175 (x3)



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## K284CV Whitefish MT, 104.7 MHz

Frequency	Harm	Dir-Coupler	NHP175 HPF	Measured	Corrected
104.7 MHz	x1	-39.48		<i>-0.20 dBm</i>	<i>Reference</i>
209.4 MHz	x2	-33.60	-1.09	-84.90	-89.49 dB
314.1 MHz	x3	-30.24	-0.58	-84.84	-93.30 dB
418.8 MHz	x4	-27.87	-0.53	-85.21	-96.09 dB
523.5 MHz	x5	-26.16	-1.62	-84.61	-96.11 dB
628.2 MHz	x6	-24.85	-2.38	-84.26	-96.31 dB
732.9 MHz	x7	-23.77	-1.25	-75.21 *	-89.47 dB
837.6 MHz	x8	-22.90	-0.58	-84.12	-99.92 dB
942.3 MHz	x9	-22.39	-0.66	-83.83	-100.06 dB

No other emissions were observed that could be attributed to K284CV

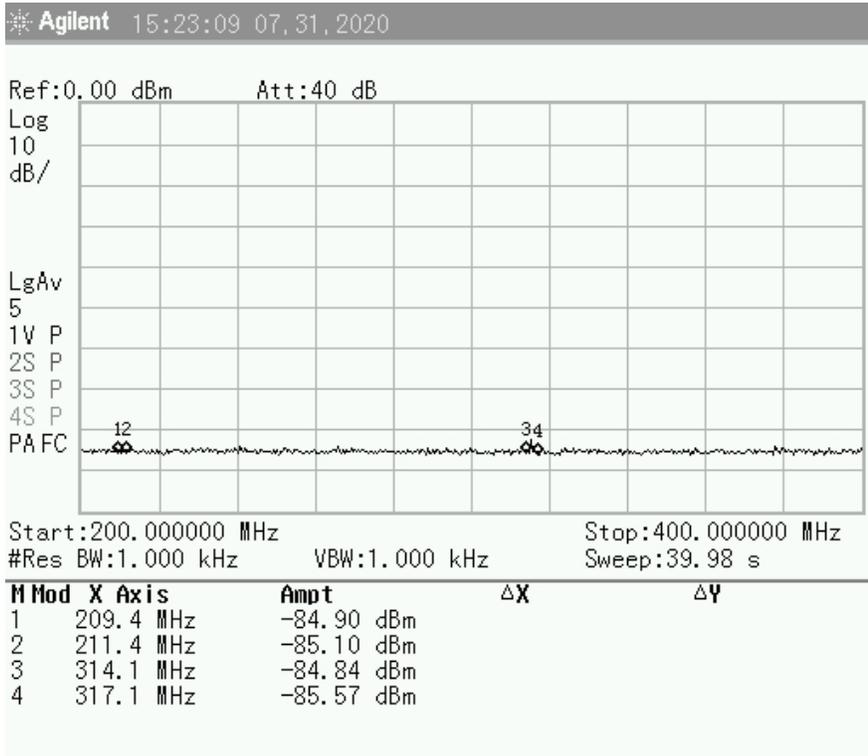
\* Note: This emission was present with both transmitters OFF

## K289CF Kalispell MT, 105.7 MHz

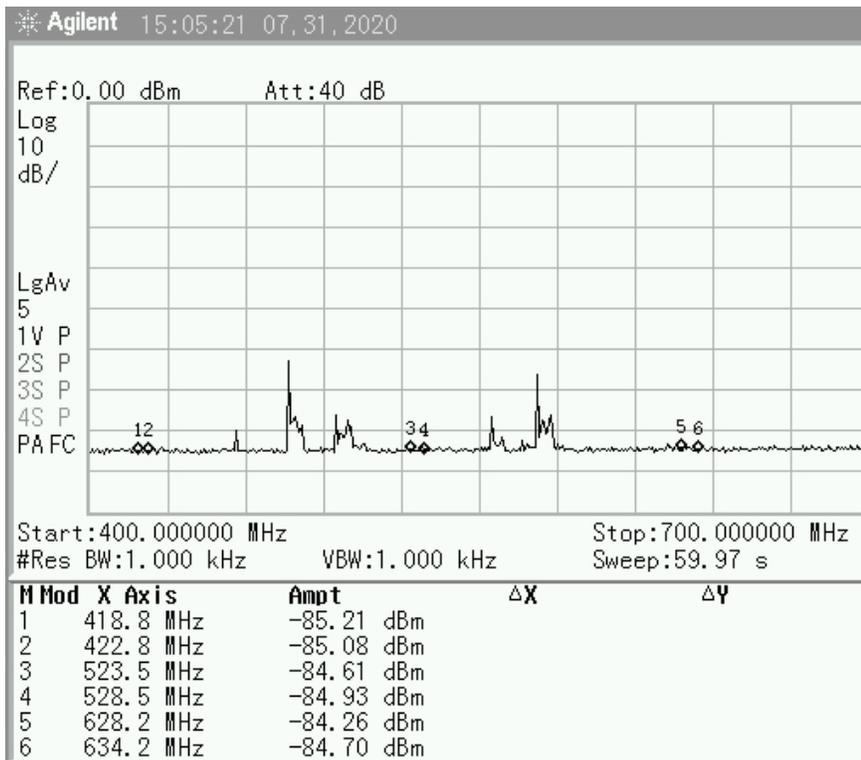
Frequency	Harmonic	Dir-Coupler	NHP-175 HPF	Measured	Corrected
105.7 MHz	x1	-39.40		<b>-0.09 dBm</b>	<b>Reference</b>
211.4 MHz	x2	-33.51	-1.05	-85.10	-89.94 dB
317.1 MHz	x3	-30.17	-0.57	-85.57	-94.14 dB
422.8 MHz	x4	-27.79	-0.53	-85.08	-96.07 dB
528.5 MHz	x5	-26.02	-1.77	-84.93	-96.45 dB
634.2 MHz	x6	-24.77	-2.22	-84.70	-97.02 dB
739.9 MHz	x7	-23.68	-1.08	-84.30	-98.85 dB
845.6 MHz	x8	-22.87	-0.59	-83.73	-99.58 dB
951.3 MHz	x9	-22.32	-0.64	-83.99	-100.34 dB

No other emissions were observed that could be attributed to K289CF

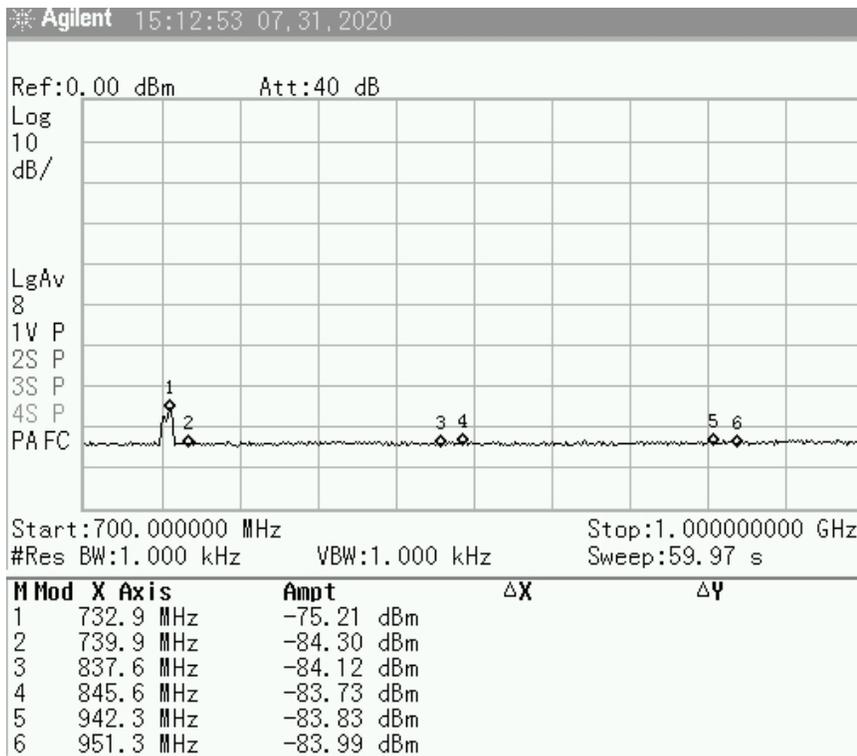
# Harmonic measurements



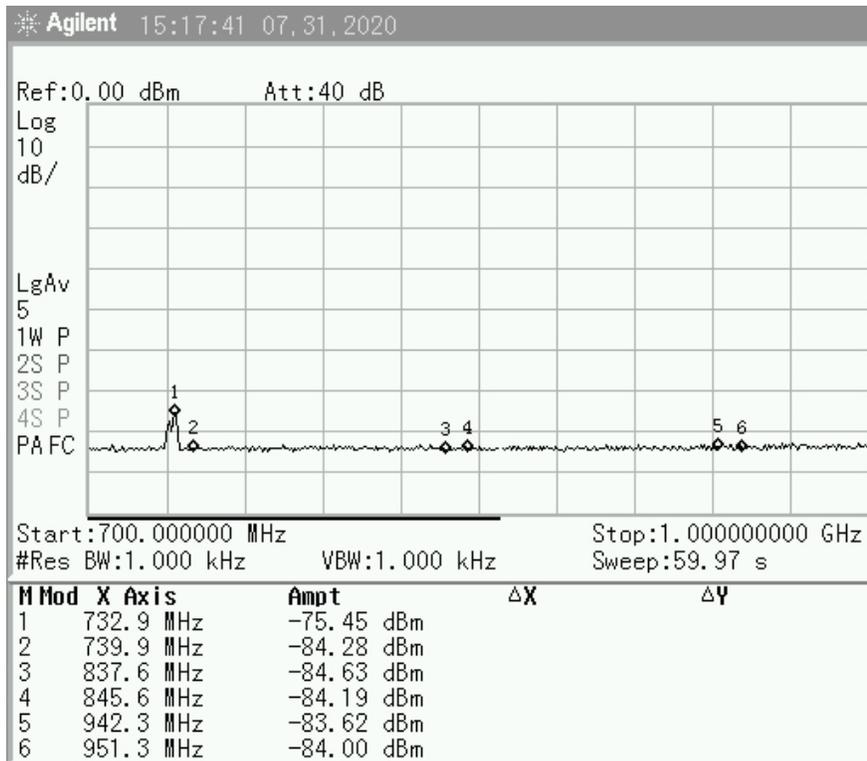
# Harmonic measurements



# Harmonic measurements

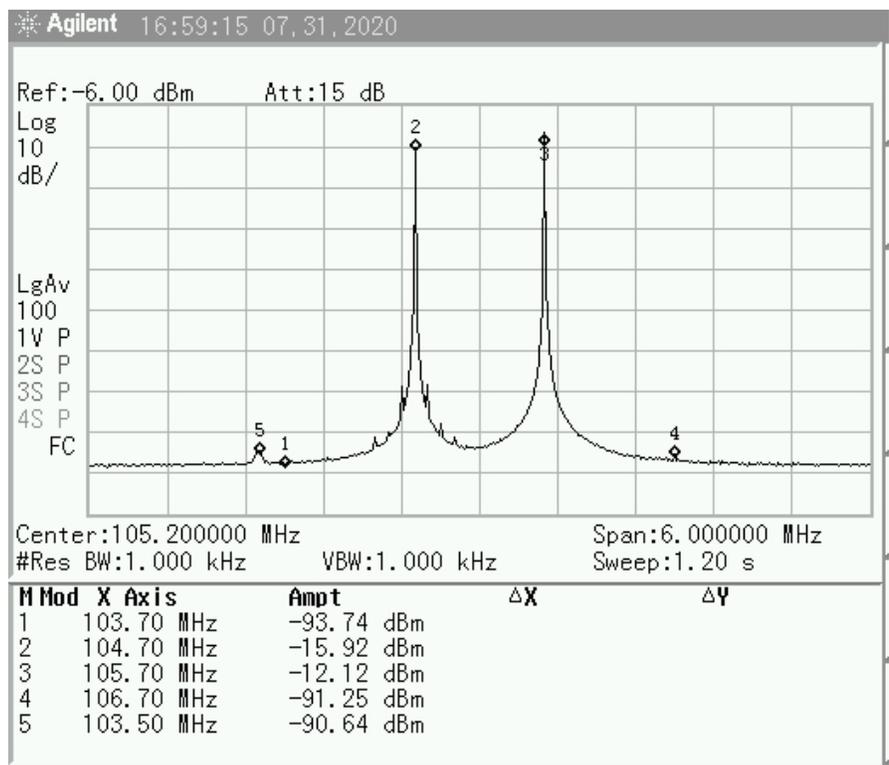


# Harmonic measurements

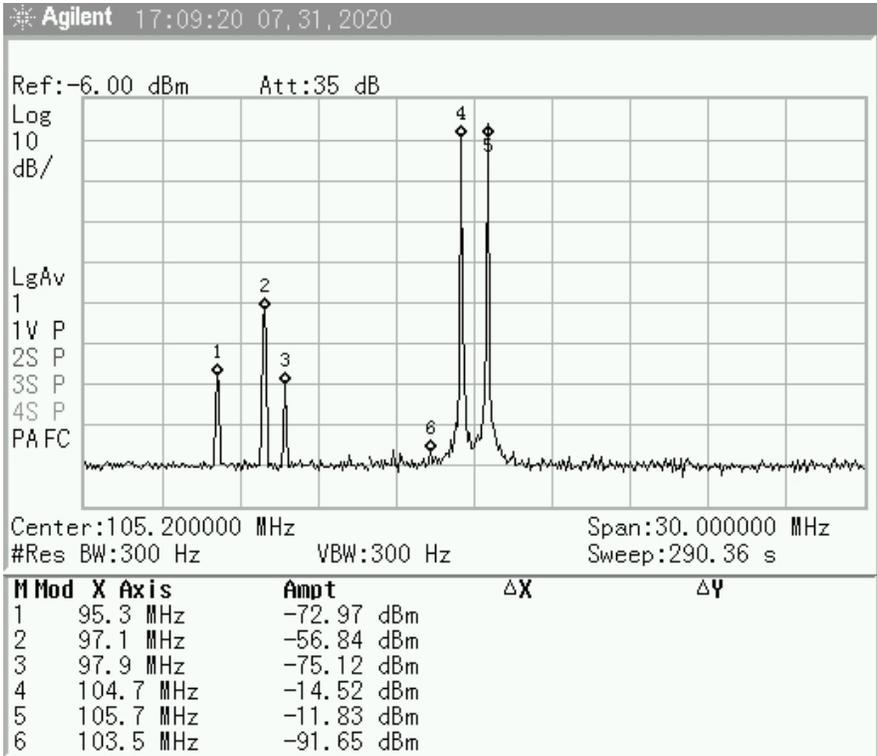


Measurement made with both transmitters OFF.  
732.9 MHz is another user at this electronic site

# Inter-mod measurement



103.7 MHz  $((104.7 \times 2) - 105.7)$  is -77.82dB below Ref  
 106.7 MHz  $((105.7 \times 2) - 104.7)$  is -79.13dB below Ref



95.3 MHz      K284CV  
 97.1 MHz      KALS  
 97.9 MHz      K250BP  
 103.5 MHz     K278BI

No other emissions that could be attributed to K284CV or K289CF were measured.