

4 Measurement Procedures

4.1 List of Test Equipment

1. Computer with Phone_T software for activating CDMA transmission mode
2. Spectrum Analyzers
 - HP8563E, S/N 3643A0680
 - HP8594E with CDMA spectrum analyzer option, S/N 3733U03464
3. DC Power Supply

4.2 Measurement Procedures

4.2.1 Conducted RF Power Output

Definition - The output power rating of the transmitter is the power available at the output terminal of the transmitter when the terminal is connected to the normal load.

Method of Measurement - The transmitter output carrier power with CDMA modulation was measured using an HP 8594E spectrum analyzer with the CDMA feature option. The measurement setup diagram is shown in Fig. 4-1.

Minimum Standard - The transmitter output power shall be maintained within range of -4dB to 2dB.

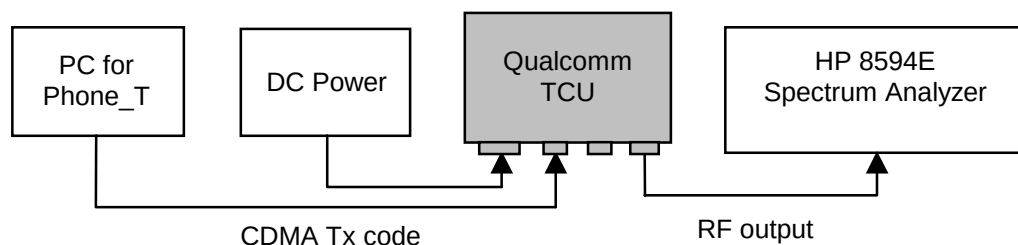


Figure 4-1. Measurement setup for conducted RF power

4.2.2 Radiated RF Power Output

Refer to TUV Product Service Test Report.

4.2.3 Occupied Bandwidth

Definition - The occupied bandwidth is defined as the spectrum noise produced at discrete frequency separations from the carrier due to all sources of unwanted noise within the transmitter in a modulated condition.

Method of Measurement - Use the spectrum analyzer and measure the CDMA spectrum, modulate with full rate. The measurement setup diagram is shown in Fig. 4-2.

Minimum Standard - The mean power of emissions from the transmitter with modulated carrier shall be attenuated below the mean power of the modulated carrier in accordance with the following.

At any frequency outside the licensed PCS frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least $43+10\log(P)$ dB, in which, P is mean output power in Watts. As the mean power of the TCU is approximately 22 dBm, the spurious emission would be 35 dB below the transmission power, equivalent to a absolute limit of -13dBm.

- For the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

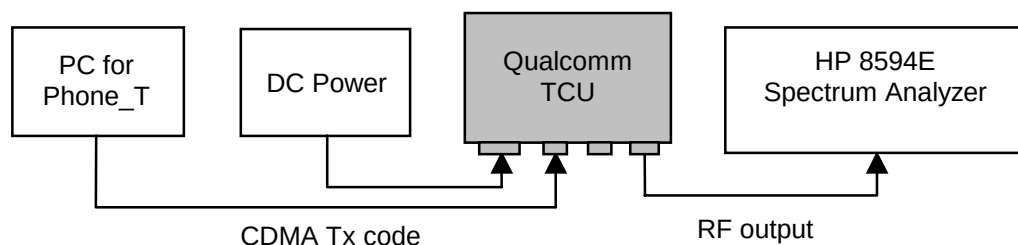


Figure 4-2. Measurement setup for Occupied Bandwidth

4.2.4 Conducted Spurious Emissions

Definition - The conducted harmonic and spurious emissions are emissions at the antenna terminals at a frequency or frequencies that are outside the authorized bandwidth of the transmitter.

Method of Measurement - The transmitter shall be modulated with CDMA at full rate. The measurement shall be made with a spectrum analyzer from the lowest radio frequency generated in the equipment to the 10th harmonic of the carrier. The measurement setup diagram is shown in Fig. 4-3.

Minimum Standard - Conducted harmonic and spurious emissions shall be attenuated below the level of emissions of the carrier frequency by at least $43+10\log(P)$ dB, in which, P is mean output power in Watts.

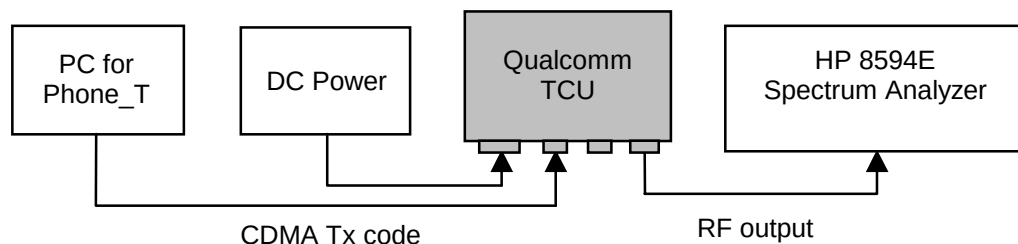


Figure 4-3. Measurement setup for conducted spurious emissions

4.2.5 Radiated Spurious emissions

Definition - The radiated spurious emissions are emissions from the TCU unit with the attached antenna fully extended. The radiated spurious emissions include those emissions radiated from the attached antenna as well as the equipment cabinet and attached cables.

Method of Measurement - The measurement shall be conducted at standard radiation test site with a search antenna, which is movable vertically and is rotatable 90 degrees for vertically and horizontally polarized signals. Refer to TUV Product Service Test Report for measurement setup

Minimum Standard - Radiated spurious emissions shall be attenuated below the maximum level of emission of the carrier frequency by at least $43+10\log(P)$ dB, in which, P is mean output power in Watts.

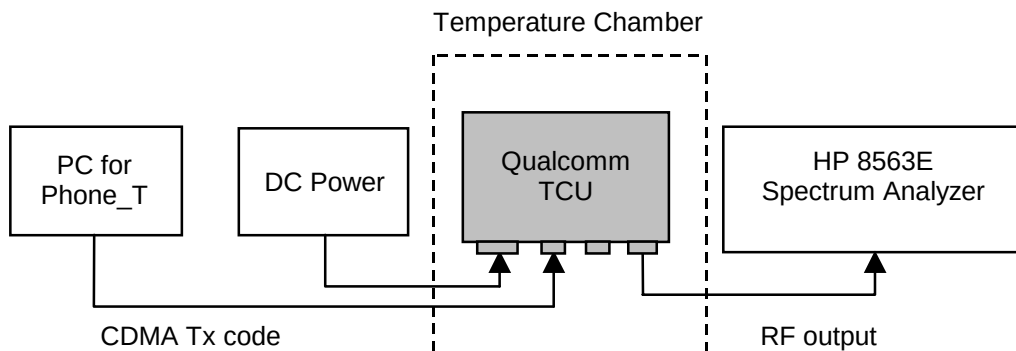
4.2.6 Frequency Stability

Definition - The frequency stability is the ability of the transmitter to maintain an assigned carrier frequency against variation in ambient temperature and power supply.

Method of Measurement - Use the spectrum analyzer to sample the transmitter RF output signal and measure its frequency under each specific temperature and power supply condition. Vary the ambient temperature from -30 to +60 °C, and also vary the DC supply voltage to the equipment from 11.2 to

1 16.8 V at each temperature. The measurement setup diagram is shown in Fig. 4-
2 4.

3 **Minimum Standard** - The transmitter carrier frequency shall be maintained
4 within ± 2.5 ppm.



5
6 **Figure 4-4. Measurement setup for frequency stability**

5 Measurement Results

5.1 Transmitter RF Power Output

5.1.1 Conducted RF Power Output

The conducted RF power output is tested per Part 2.1046(a). The RF output power was measured using a HP 8594E Spectrum Analyzer that has the CDMA spectrum analyzer option. The antenna cable of the equipment is terminated to a 50 ohms resistive load of the Spectrum Analyzer. The nominal maximum power from the CDMA phone module is 200mW. Taking account the cable loss, the power level measured represents the power from the RF port of the equipment. Table 5-1 and Fig. 5-1 to Fig. 5-3 show the measured data and waveform.

Table 5-1. Conducted RF power output (W)

Transmission Channel	Carrier frequency (MHz)	RF power in CDMA mode
25	1851.25	0.185
600	1880	0.182
1175	1908.75	0.178

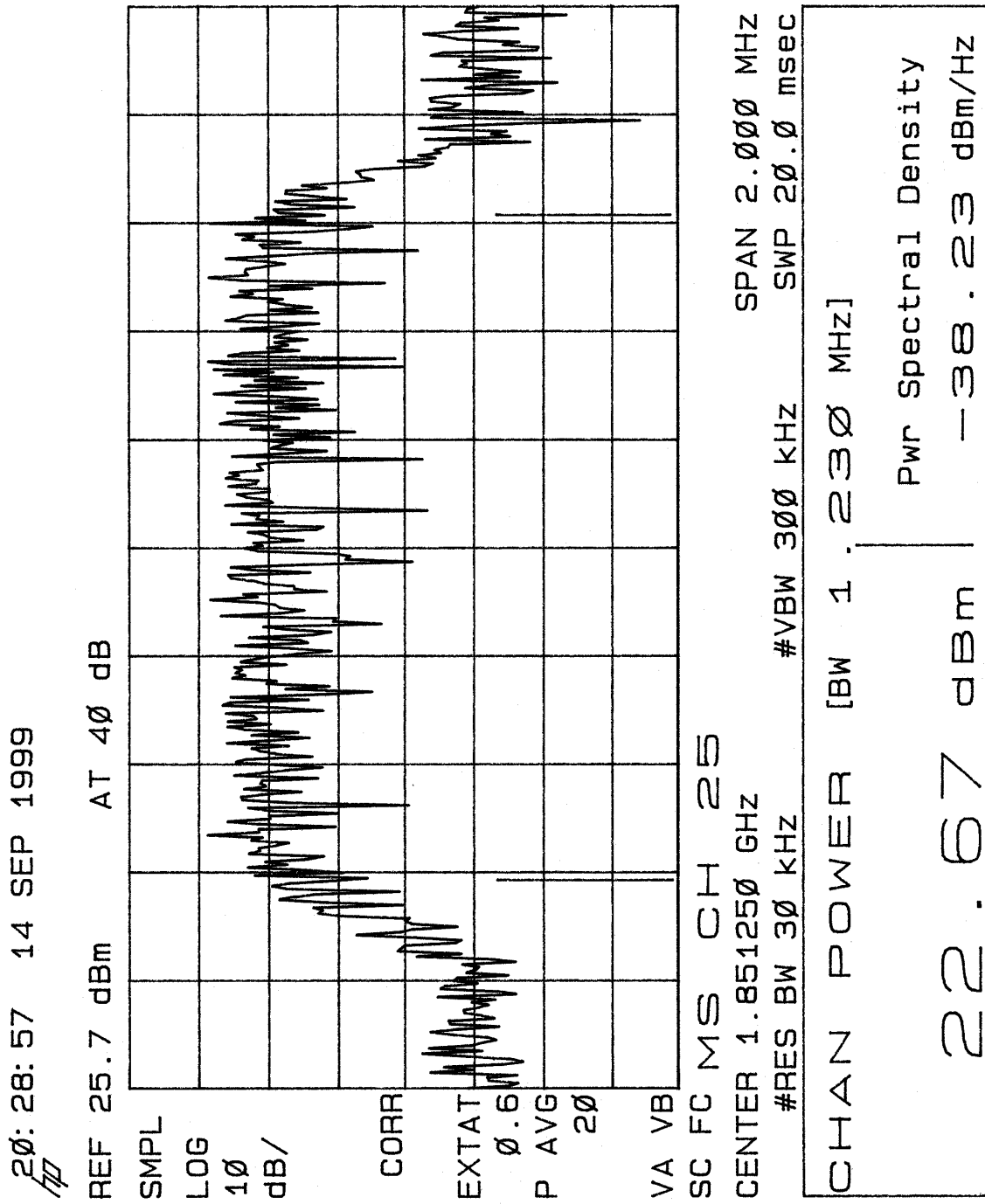


Figure 5-1. Power level on channel 25

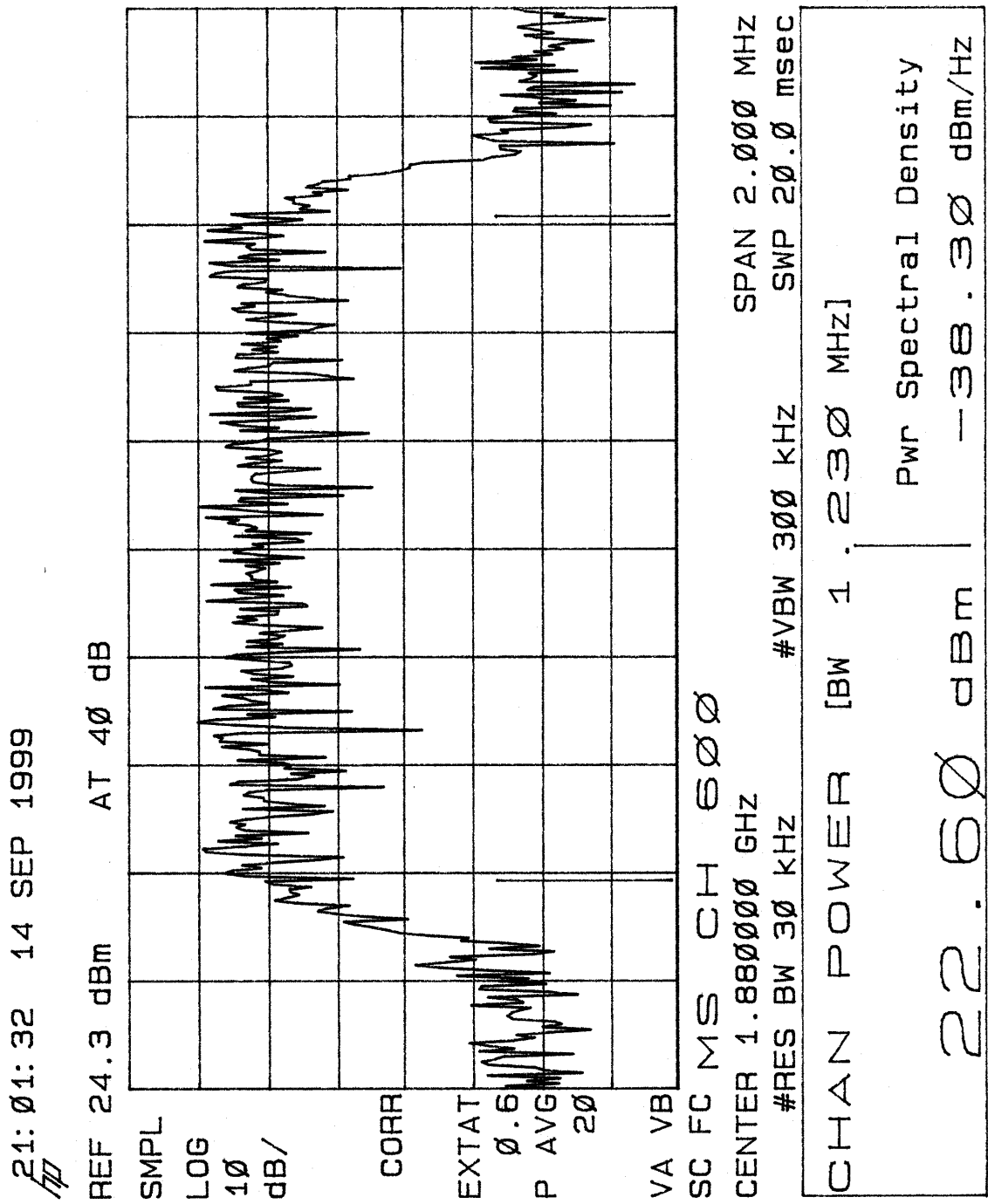


Figure 5-2. Power level on channel 600

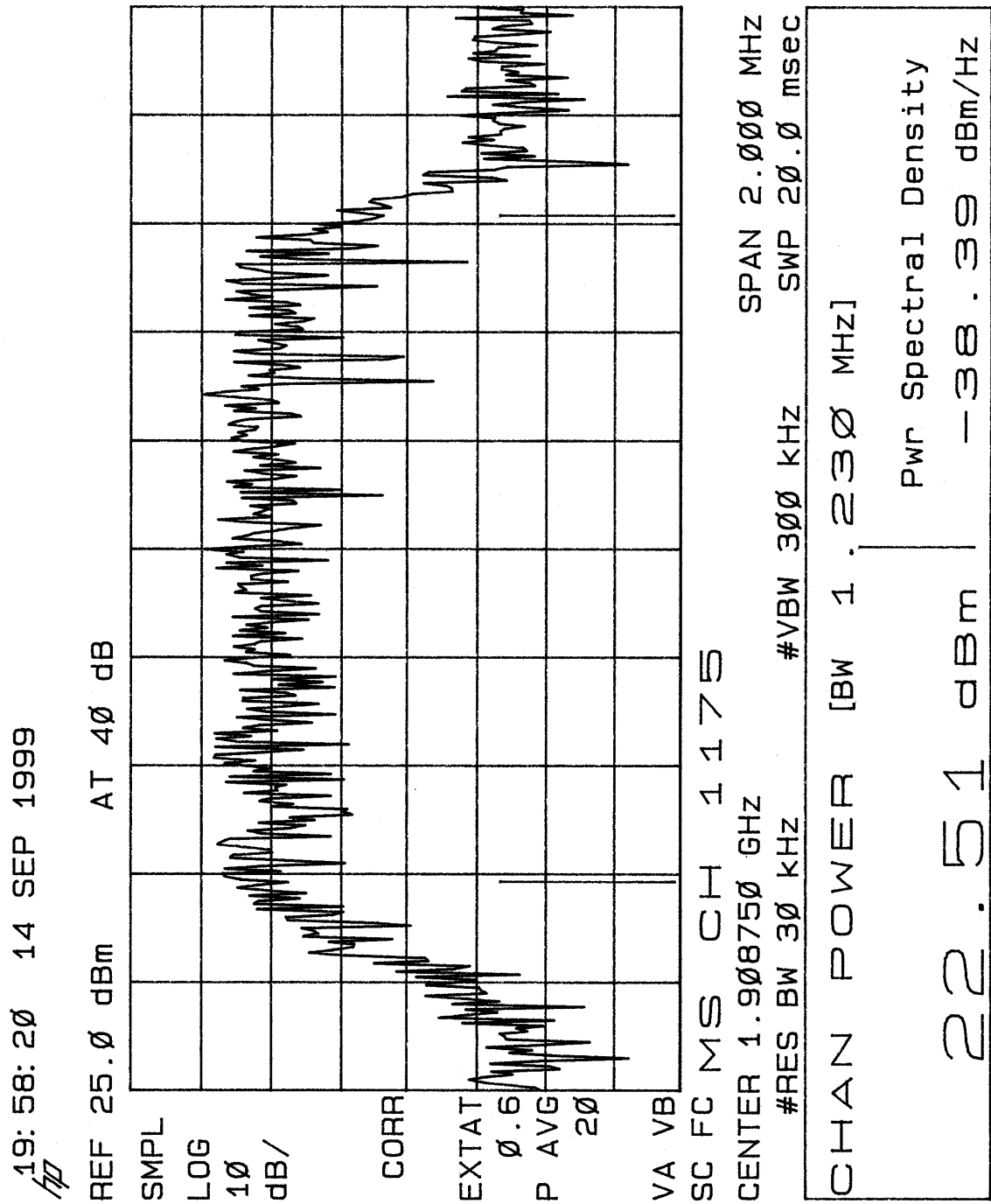


Figure 5-3. Power level on channel 1175

5.1.2 Radiated RF Power Output

The radiated RF power output is calculated using the following (EIRP) equations

$$P = \frac{d^2}{30} (E_{\theta}^2 + E_{\phi}^2) \quad (5-1)$$

where P represents the EIRP power output in CDMA mode. E_{θ} and E_{ϕ} are measured vertical electric field strength and horizontal electric field strength, respectively. d is the distance of 3 meters between the EUT source and measurement point. Table 5-2 and Table 5-3 give the EIRP power level pursuant to equation (5-1) for whip antenna configuration and dual-band antenna configuration. Refer to TUV Product Service Test Report for the measured electric field strength under different antenna configurations.

Table 5–2. Radiated RF power output from whip antenna

Channel	FREQ (MHz)	V-Voltage (dBuV)	H-Voltage (dBuV)	Factor (dB/m)	V-field (dBuV/m)	H-field (dBuV/m)	EIRP (W)
25	1851.25	79.80	72.40	29.50	109.30	101.90	0.030
60	1880.00	79.80	68.80	32.30	112.10	101.10	0.053
1175	1908.75	84.20	71.70	32.50	116.70	104.20	0.148

Table 5–3. Radiated RF power output from dual-band antenna

Channel	FREQ (MHz)	V-Voltage (dBuV)	H-Voltage (dBuV)	Factor (dB/m)	V-field (dBuV/m)	H-field (dBuV/m)	EIRP (W)
25	1851.25	84.70	72.40	29.50	114.20	101.90	0.084
60	1880.00	88.00	68.80	32.30	120.30	101.10	0.325
1175	1908.75	86.10	76.00	32.50	118.60	108.50	0.239

5.2 Occupied Bandwidth

Occupied Bandwidth of the equipment was tested pursuant to FCC Part 2.1049. The measurement was conducted using HP 8594E spectrum analyzer with CDMA feature option. The measured data is shown in Table 5-4 and Fig.5-4 through Fig.5-6.

Table 5–4. Occupied Bandwidth (99%)

Transmission Channel	Carrier frequency (MHz)	Occupied bandwidth (MHz)
25	1851.25	1.275
600	1880	1.275
1175	1908.75	1.275

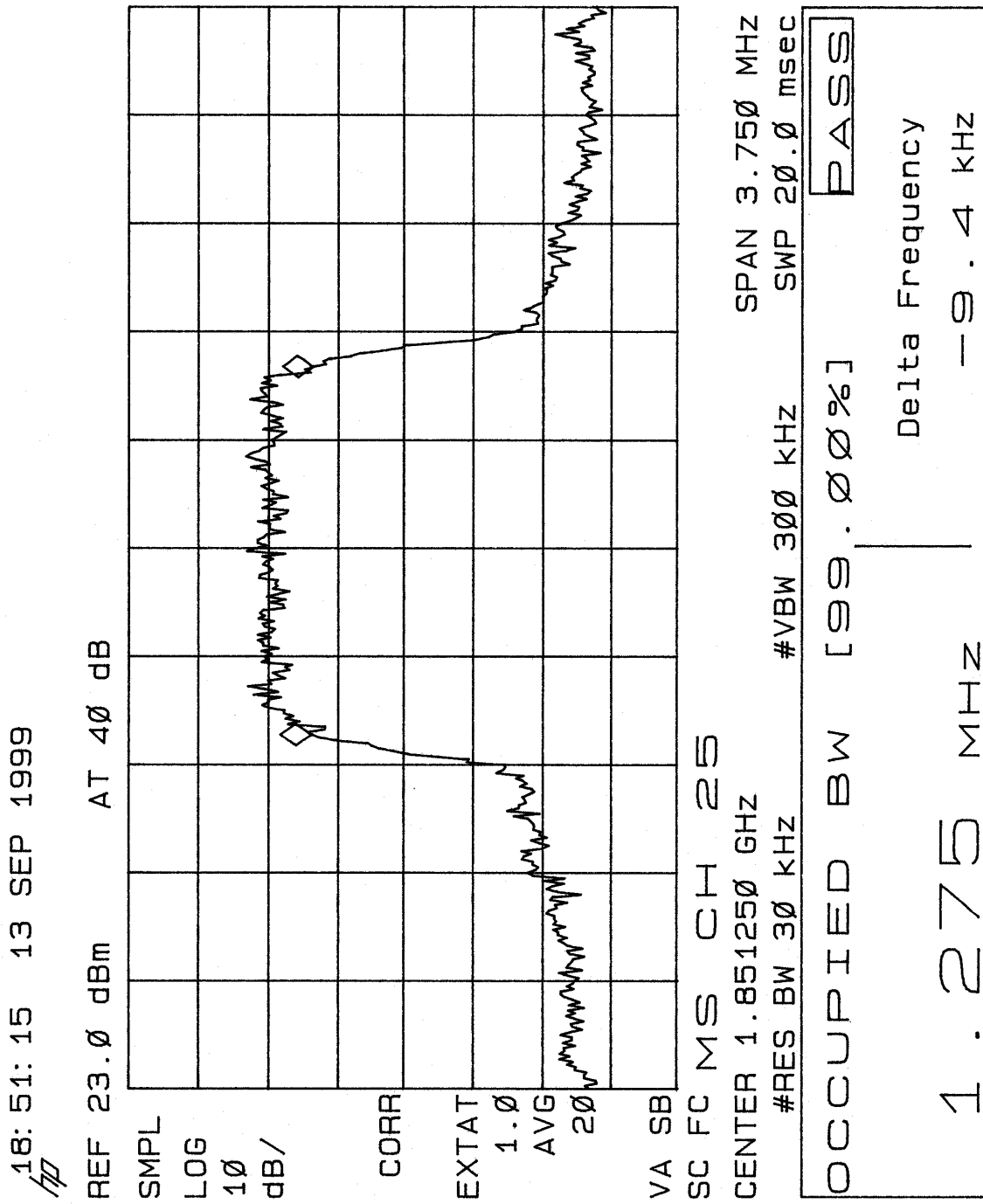


Figure 5-4. Occupied bandwidth on channel 25

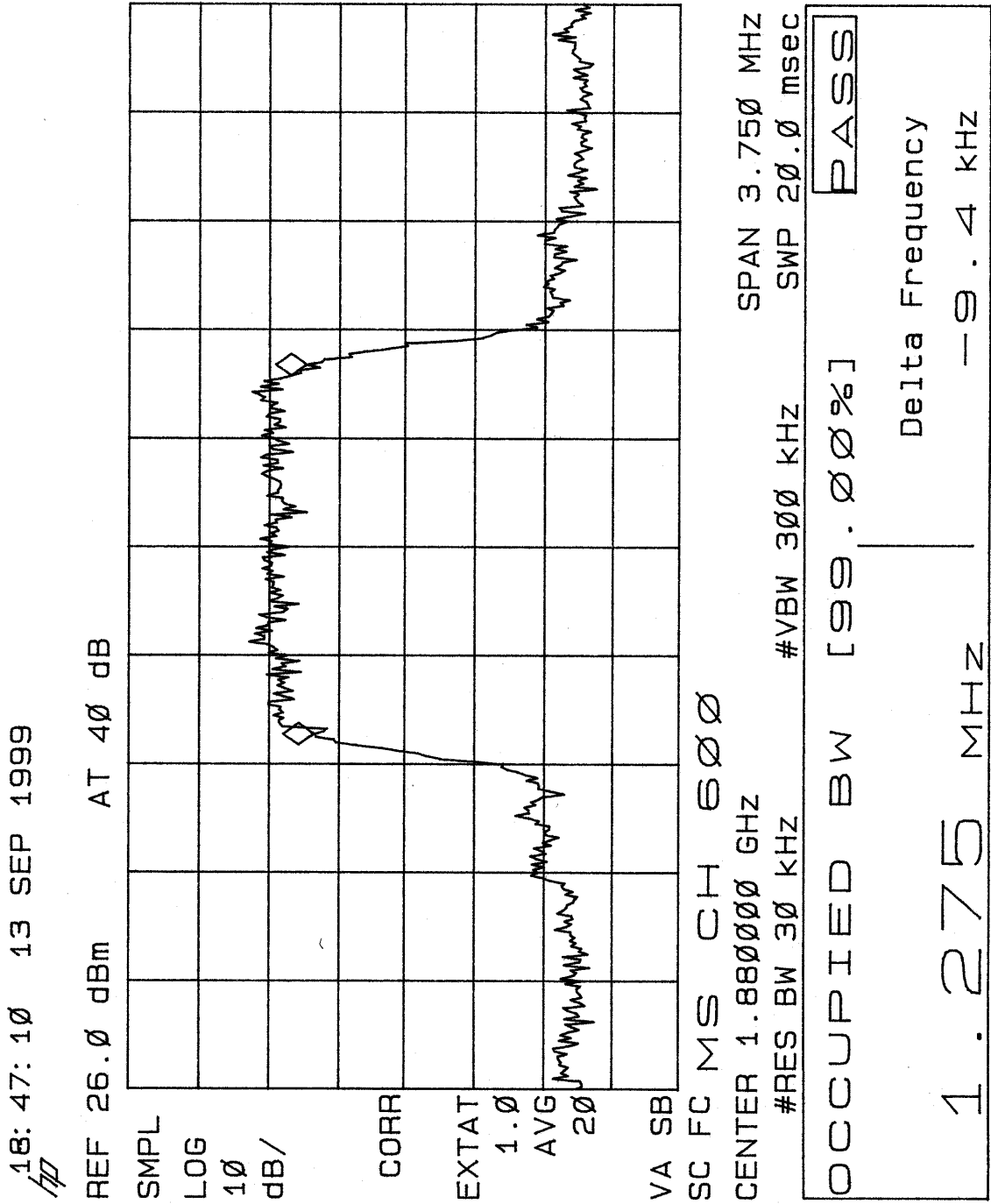


Figure 5-5. Occupied bandwidth on channel 600

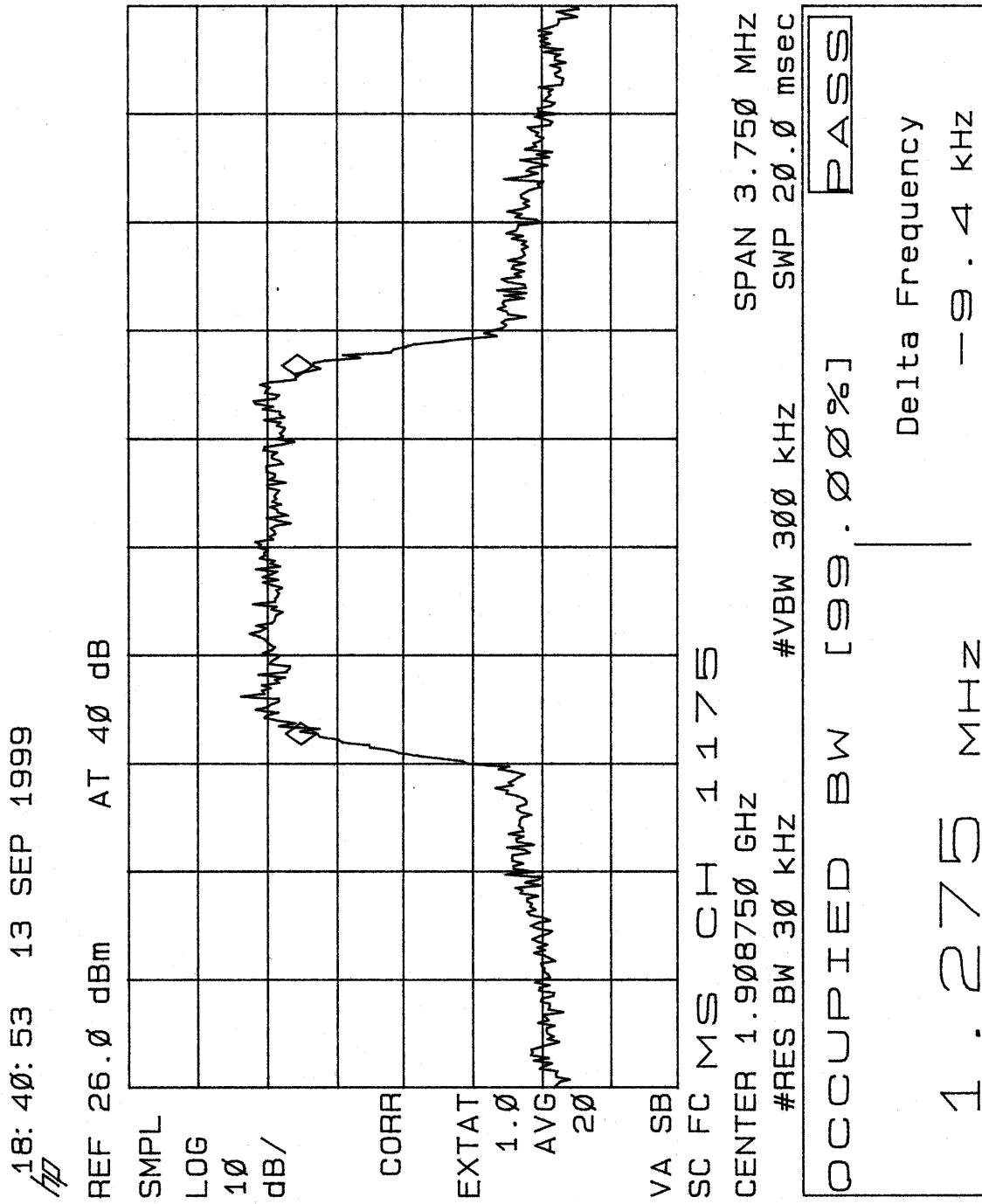


Figure 5-6. Occupied bandwidth on channel 1175

5.3 Conducted Spurious Emission

Conducted emission from the equipment was tested pursuant to FCC Part 2.1046 and 24.238. Measurement was conducted using HP 8594E spectrum analyzer with CDMA analyzer option for channel band and HP 8593 spectrum analyzer for other frequency. An actual 2 feet long antenna cable was used to connect the equipment RF port to the analyzer, which has 50 ohm coaxial resistive load. Total nominal cable loss is 0.65 dB. The measurement results are shown in the Table 5-5 through Table 5-7 and Fig.5-7 through Fig.5-12.

Table 5-5. Conducted spurious emission at low-band (channel 25)

Harmonics	Frequency (MHz)	Measured level (dBm)	Limit (dBm)	Measurement attenuation
1	1851.25	22.17	-13.00	40.00
2	3702.50	-59.50	-13.00	10.00
3	5553.75	-60.83	-13.00	10.00
4	7405.00	-63.83	-13.00	10.00
5	9256.25	-75.67	-13.00	10.00
6	11107.50	-82.17	-13.00	10.00
7	12958.75	<-83.00	-13.00	0.00
8	14810.00	<-87.50	-13.00	0.00
9	16661.25	<-87.50	-13.00	0.00
10	18512.50	<-87.50	-13.00	0.00

Table 5-6. Conducted spurious emission at mid-band (channel 600)

Harmonics	Frequency (MHz)	Measured level (dBm)	Limit (dBm)	Measurement attenuation
1	1880.00	22.00	-13.00	40.00
2	3760.00	-61.17	-13.00	10.00
3	5640.00	-70.00	-13.00	10.00
4	7520.00	-72.83	-13.00	10.00
5	9400.00	-77.50	-13.00	10.00
6	11280.00	-80.33	-13.00	10.00
7	13160.00	<-82.33	-13.00	0.00
8	15040.00	<-83.50	-13.00	0.00
9	16920.00	<-83.50	-13.00	0.00
10	18800.00	<-83.50	-13.00	0.00

Table 5–7. Conducted spurious emission at high-band (channel 1175)

Harmonics	Frequency (MHz)	Measured level (dBm)	Limit (dBm)	Measurement attenuation
1	1908.75	22.00	-13.00	40.00
2	3817.50	-60.50	-13.00	10.00
3	5726.25	-73.33	-13.00	10.00
4	7635.00	-77.67	-13.00	10.00
5	9543.75	-79.67	-13.00	10.00
6	11452.50	-75.83	-13.00	10.00
7	13361.25	<-87.17	-13.00	0.00
8	15270.00	<-87.17	-13.00	0.00
9	17178.75	<-87.17	-13.00	0.00
10	19087.50	<-87.17	-13.00	0.00

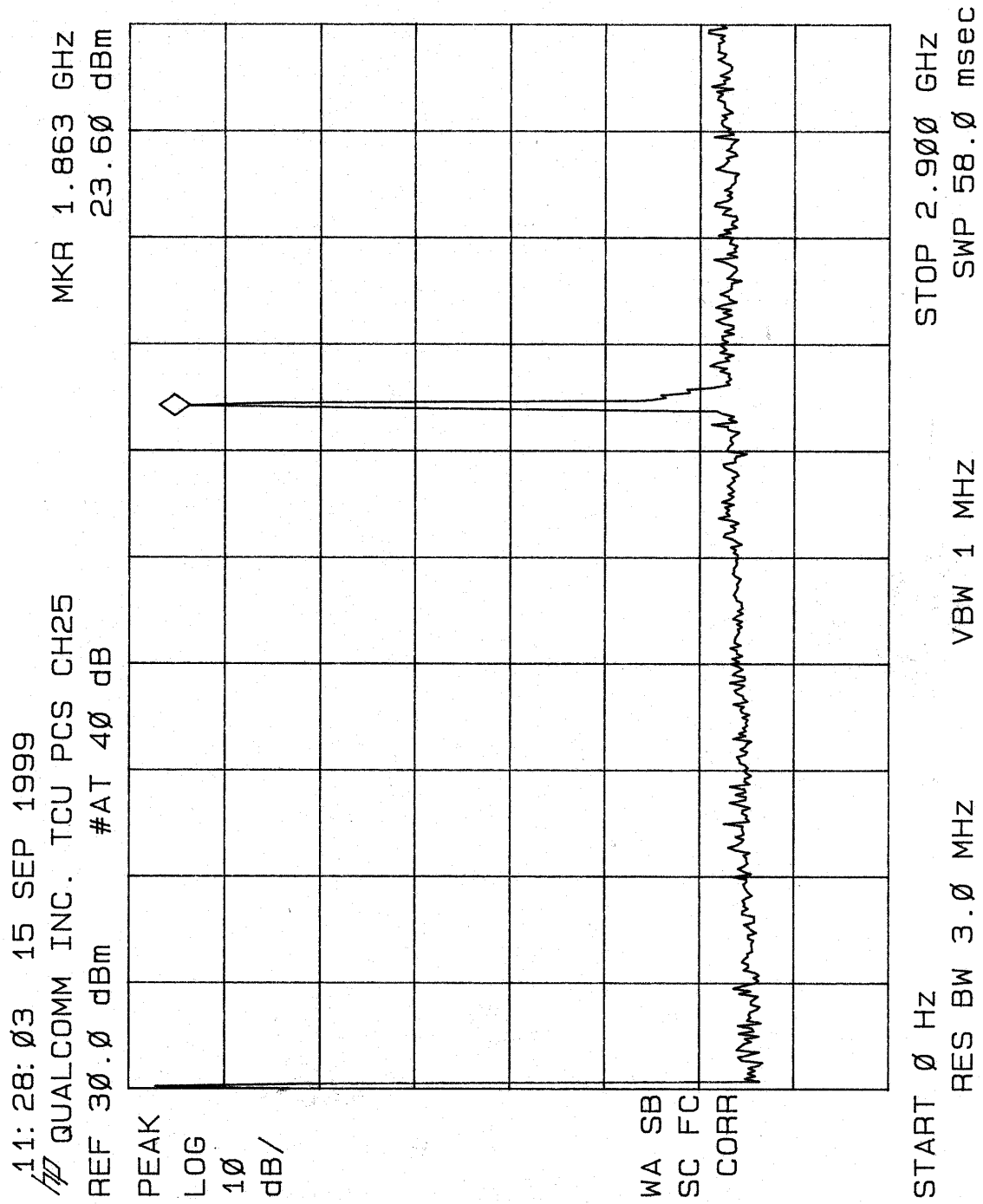


Figure 5-7. Overall profile under channel 25 (0-2.9GHz)

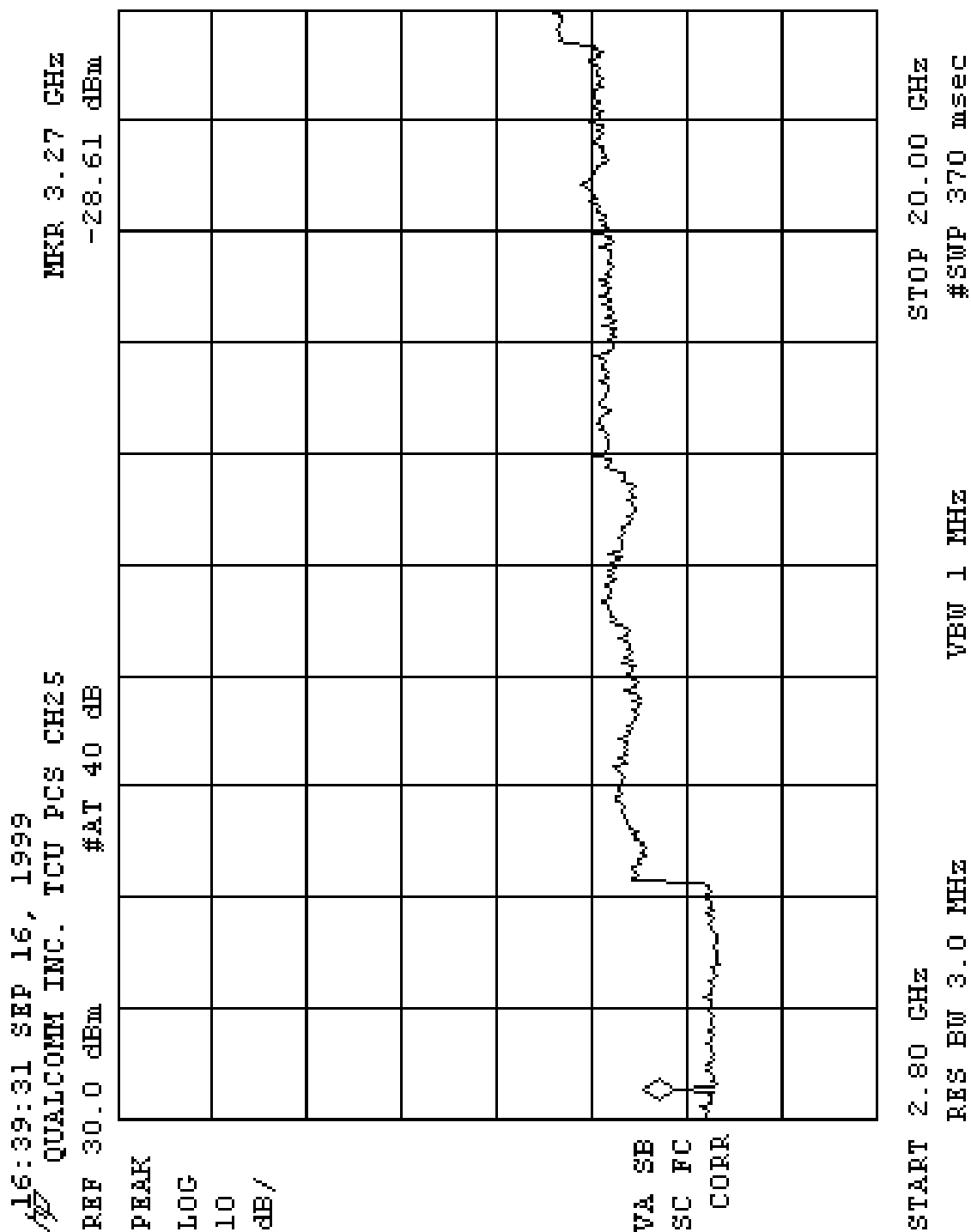


Figure 5-8. Overall profile under channel 25 (2.8-20GHz)

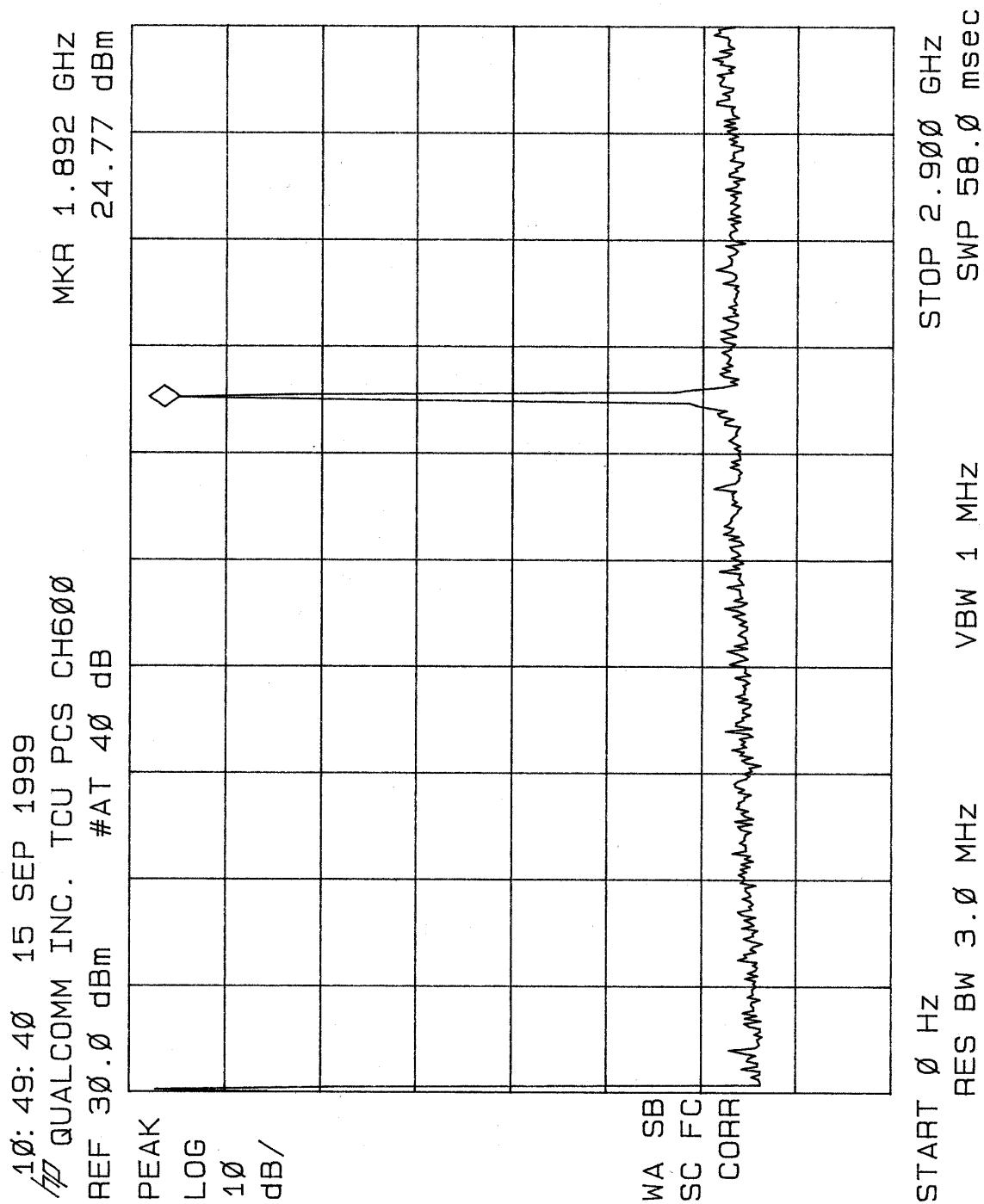


Figure 5-9. Overall profile under channel 600 (0-2.9GHz)

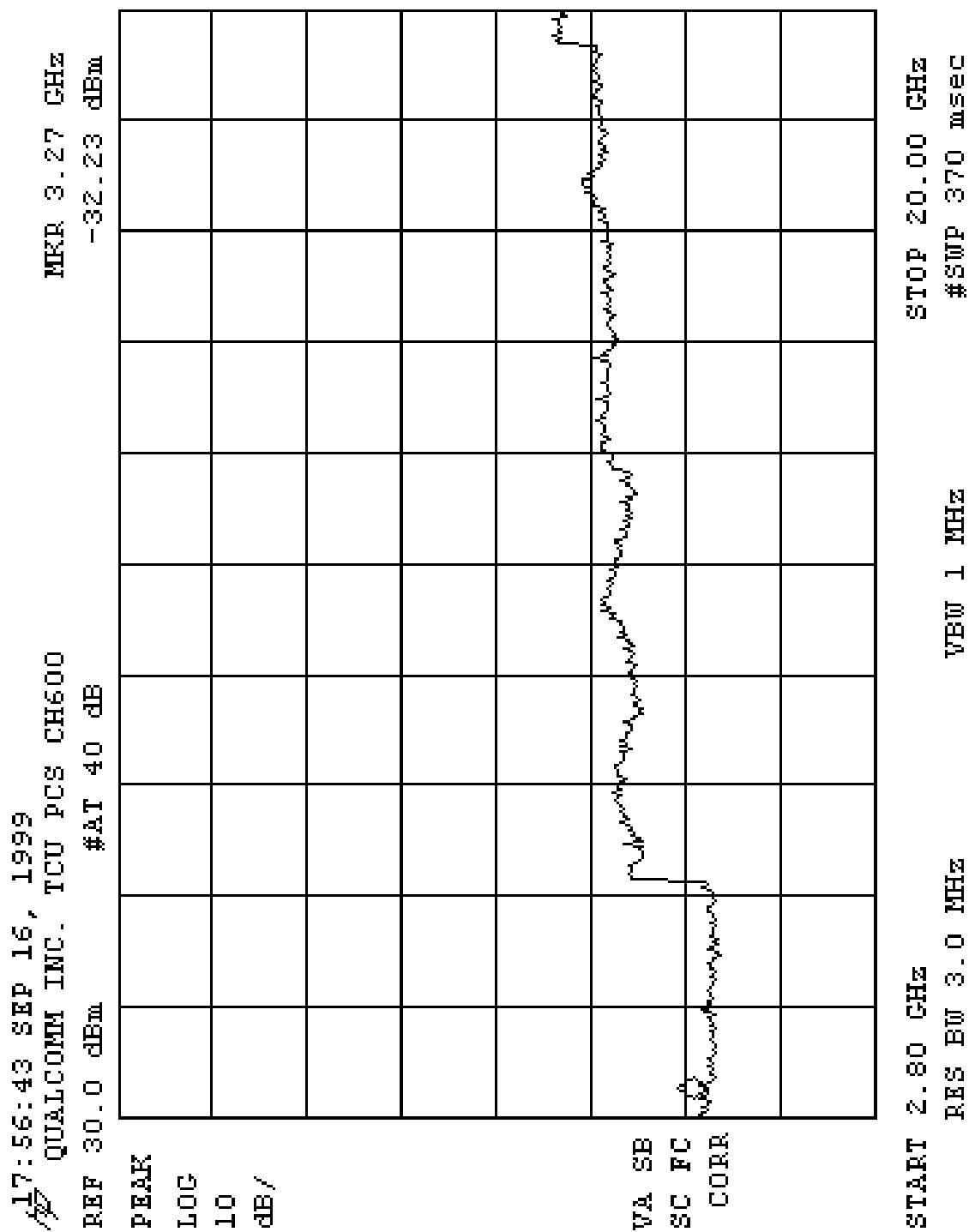


Figure 5–10. Overall profile under channel 600 (2.8-20GHz)

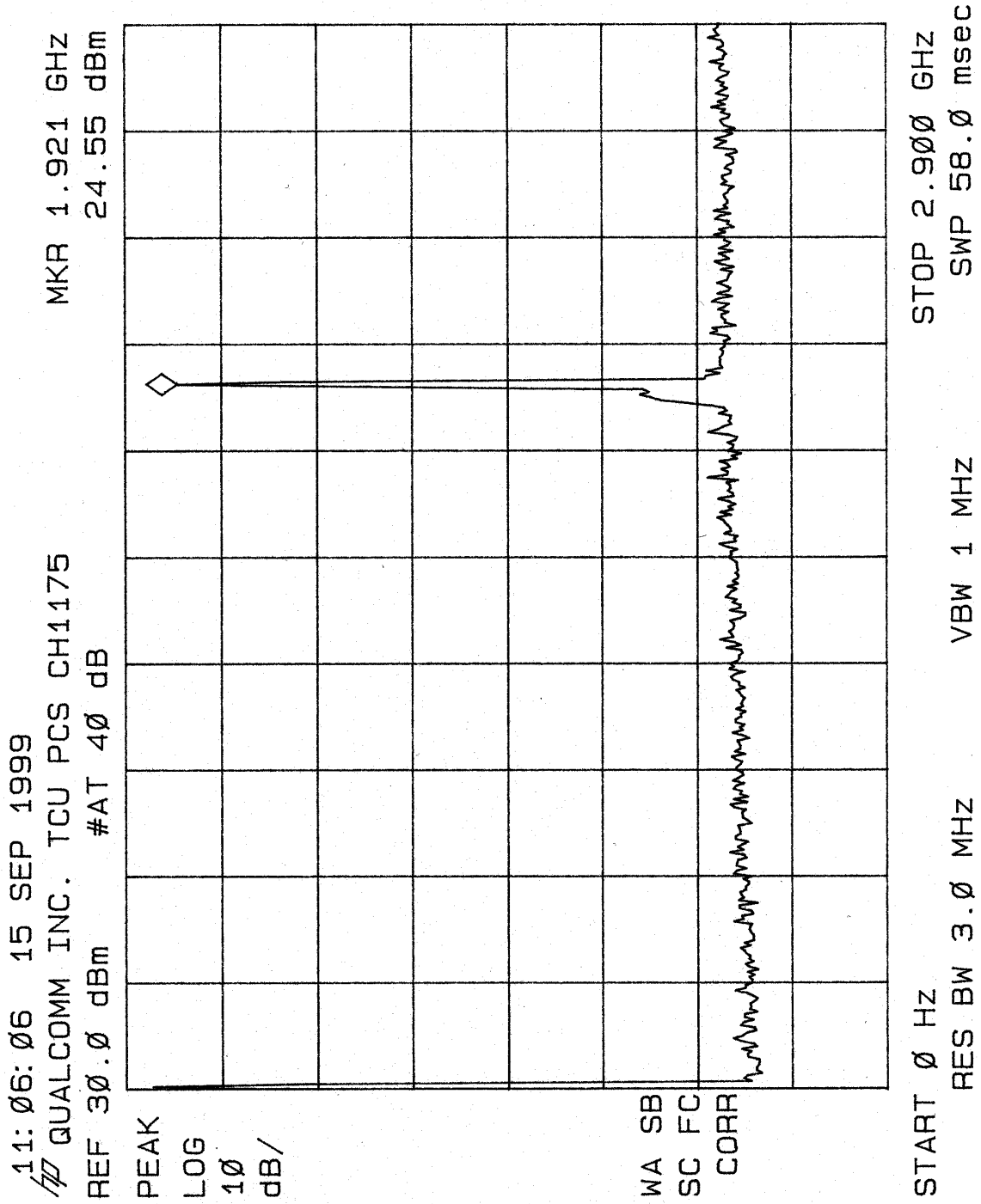


Figure 5-11. Overall profile under channel 1175 (0-2.9GHz)

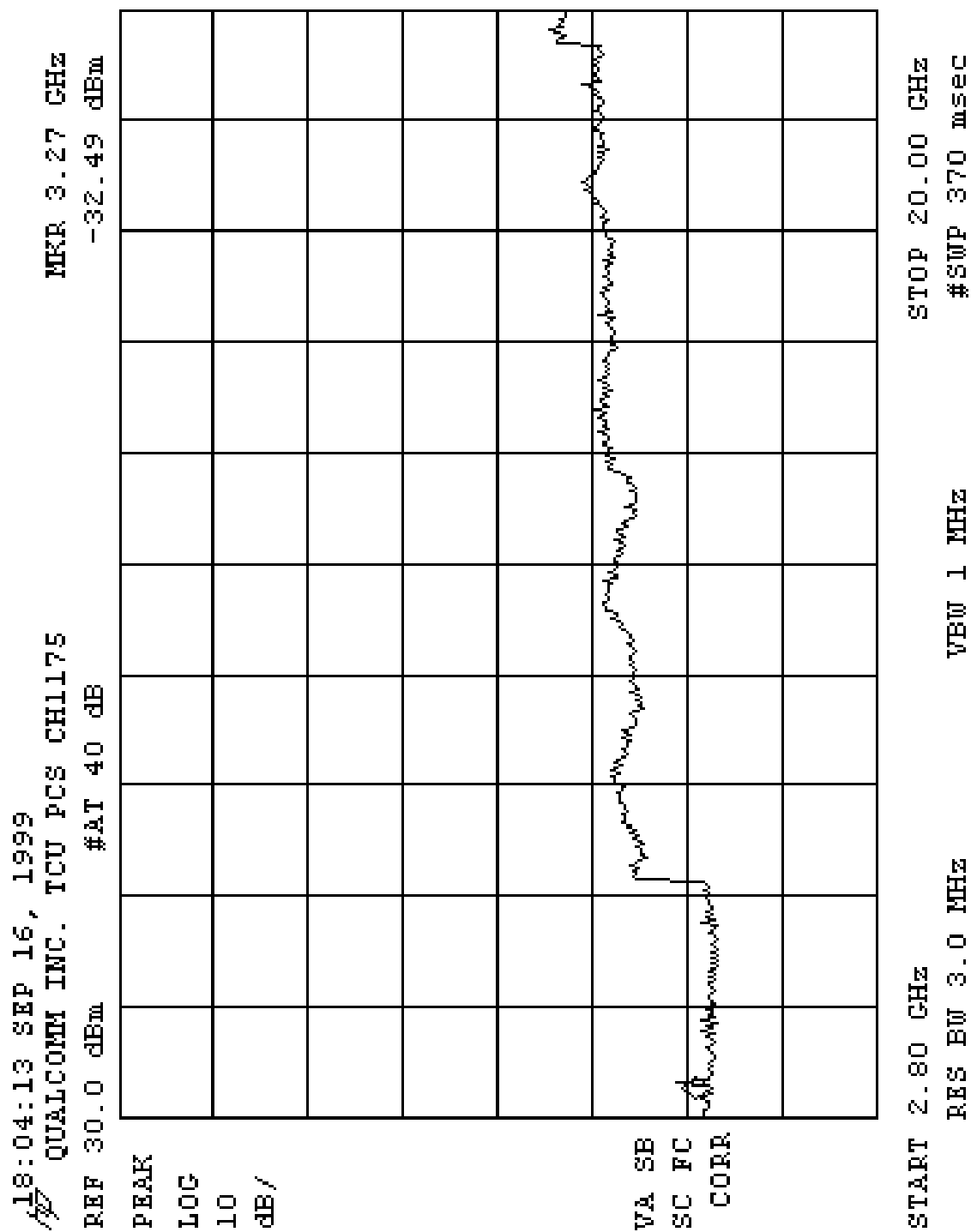


Figure 5–12. Overall profile under channel 1175 (2.8-20GHz)

5.4 Radiated Spurious Emissions

Refer to TUV Product Service Test Report.

5.5 Frequency Stability

Frequency stability of the equipment versus temperature and power supply change was tested pursuant to FCC Part 2.1055. Measurement was conducted in CDMA channel 600 transmitting mode without modulation on the carrier frequency (1880MHz). CSZ Dimension Series 60 Chamber was used to stabilize a specific temperature and HP 8563E spectrum analyzer was used to monitor frequency stability.

Table 5–8. Offset (Hz) from carrier frequency of channel 600

Temperature (°C)	External DC power supply (V)					Specification (Hz)
	11.2	12.6	14 (Nom)	15.4	16.8	
-30	710	717	720	713	707	± 4700
-20	365	367	377	377	387	± 4700
-10	243	248	255	267	265	± 4700
0	128	135	142	145	148	± 4700
10	55	60	60	62	65	± 4700
20	8	3	0	7	10	± 4700
30	205	208	203	205	210	± 4700
40	217	217	212	205	193	± 4700
50	-680	-687	-699	-707	-700	± 4700
60	-1442	-1458	-1458	-1457	-1450	± 4700