

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
Biennial Regulatory Review – Amendment)	WT Docket No. 03-264
of Parts 1, 22, 24, 27, and 90 to Streamline)	
and Harmonize Various Rules Affecting)	
Wireless Radio Services)	

Comments of Powerwave Technologies, Inc.

Powerwave Technologies, Inc. (“Powerwave”), by its attorneys, pursuant to Section 1.415 of the Commission’s rules, hereby submits its comments in the above-referenced proceeding. Powerwave is a leading international supplier of radio frequency power amplifiers. Powerwave designs, manufactures and markets single and multi-carrier ultra-linear power amplifiers for a variety of radio services and transmission protocols.¹ The company’s products are key components in wireless communications networks, including cellular, Personal Communications (PCS) and Advanced Wireless Services (3G). Because the Commission, in this docket, is proposing to change the way in which RF power is currently measured for broadband PCS base station equipment, Powerwave and its customers have a stake in, and will be directly impacted by, the outcome of this proceeding.

Powerwave’s comments are directed specifically to the Commission’s request for input on the possible amendment of Section 24.232(a) of the rules, to either clarify that the output power limit of 100 watts applies on a per carrier (rather than per transmitter)

¹ For the purpose of this filing the following acronyms will be used: LPA to mean linear power amplifier; SCPA to mean single-carrier power amplifier; and MCPA to mean multi-carrier power amplifier.

basis in the case of MCPAs or to eliminate the output power restriction entirely.² The Commission's proposal is in response to a request by Powerwave, set forth in its comments on the Biennial Review in WT Docket No. 02-310³, as well as the subsequent recommendations of the Commission's staff to entertain such request.⁴

It remains Powerwave's contention that the use of MCPAs is unreasonably restricted by the present rule and that the Commission should, at the very least, amend Section 24.232(a) to specify output power limits on a per carrier basis. More appropriately, Powerwave urges the Commission to eliminate the output power restriction entirely and rely on an EIRP limit of 1640 watts per carrier for broadband PCS.⁵

Background

As Powerwave explained in its comments to the Biennial Review in Docket No. 02-310, much of the confusion in the application of Section 24.232(a) is based on imprecise use over the last ten years of the terms, "transmitter," "channel," "base station," and "carrier." In 1993, when the broadband PCS service rules were first adopted the Commission established a power level of 100 watts EIRP for each base

² Logically any clarification that the 100 watt limit applies to MCPAs on a per carrier basis applies to SCPAs as well.

³ See Comments of Powerwave in response to Public Notice FCC 02-264, The Commission Seeks Public Comment in the 2002 Biennial Review of Telecommunications Regulations Within the Purview of the Wireless Telecommunications Bureau, September 26, 2002.

⁴ It should be noted that Powerwave also recommended to the Commission that the EIRP limits be changed to a per carrier requirement. As we show below, based on the Commission's "clarification" of its rules in 1994, the EIRP restriction was intended to apply on a per channel, or more properly, on a per carrier basis rather than a per base station basis as the rule currently provides.

⁵ Powerwave filed similar comments in its pending Petition for Reconsideration in WT Docket no. 02-353 (Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands). In that proceeding the Commission adopted almost identical language to Section 24.232(a) for the measurement of output power and EIRP from 3G base stations. Because the issues are the same, Powerwave asked the Commission to hold application of the 3G power limits in abeyance until this proceeding has been completed.

station. No transmitter output limits were required and no definition of “base station” was provided.⁶ In early 1994, upon reconsideration of the new rules, the Commission did two things: it raised the EIRP limit to 1640 watts per base station (although still without any definition of base station); and, in an effort to ensure that PCS downlinks and uplinks were in balance (so that signals from base stations would not extend beyond a mobile unit’s ability to respond) it added a 100 watt peak power restriction on transmitter output.⁷ The term “transmitter,” however, was undefined. Later in 1994, the Commission “clarified” the rule in response to industry objections that the narrowband PCS rules, which limited power on a per channel basis, permitted greater power per unit of bandwidth than did the rules for broadband PCS. The Commission responded by explaining:

As regards power levels per transmitter, antenna or antenna element, it was always our intent that the 100 watts per channel and 1640 watts EIRP requirements apply to these individual components and not to the sum of all components at the entire base station provided the maximum EIRP radiated by the base station in any given direction on any given channel does not exceed 1640 watts.”⁸

Here was some progress, if not total clarity. The Commission had moved from an EIRP limit per base station and peak power limit per transmitter to both EIRP and peak power limits per channel. There were, however, two problems with this clarification. First, Section 24.232 was not amended to reflect the per channel clarification and so remains to this day as it was adopted early in 1994. Second, the Commission did not define the term “channel” leaving the industry to puzzle over what the Commission

⁶ *Second Report and Order* in Docket No. 90-314, 8 FCC Rcd 7700 (1993)

⁷ *Reconsideration of the Second Report and Order* in Docket 90-314, 9 FCC Rcd 4957 (1994)

⁸ *Third Memorandum Opinion and Order on Reconsideration* in Docket 90-314, 9 FCC Rcd 6908, 6918 (1994) (emphasis added).

meant by this term. Adding to the confusion was the fact that unlike narrowband PCS, in which the spectrum is specifically channelized, broadband PCS frequencies are assigned by block. Within a block a licensee is free to channelize as it wishes; thus, the term “channel” *per se* has little independent meaning in broadband PCS except insofar as it logically refers to some part of a spectrum block assigned to a PCS licensee.

Over the years, the terms “channel” and “carrier” have been used interchangeably by the industry. In the PCS world, depending on the air interface or protocol used, each block of spectrum is divided into discrete carriers (or radio channels) with each carrier used to transmit one or more voice or data channels. Indeed, on any given carrier there can be encoded many traffic channels (in some cases 20 or more). Looking back to the 1994 clarification, one can only presume that the Commission did not intend to establish an EIRP level of 1640 watts on a per (voice/data) channel basis. The only sensible interpretation, therefore, and the one which the PCS industry has come to adopt, is to limit power on a per carrier basis. This is a critical fact because the notion of a per carrier power level determines not only how base stations are designed and built but also how they are able to evolve to meet subscriber growth and community demands.

Power Limits for PCS Must be on a Per Carrier Basis

Since 1994, when the present Section 24.232(a) was adopted, the PCS market has undergone dramatic subscriber growth and institutional change. To meet subscriber demand, which has literally exploded in recent years, PCS operators have focused on three possible solutions: acquiring additional PCS spectrum; adding new base stations to increase capacity; or increasing the traffic-handling capacity of existing PCS

infrastructure. Because mobile radio spectrum is limited and new allocations require a long lead time the first solution has not proved very fruitful. The second solution has also faced hurdles because new tower construction is opposed today in virtually all communities. Consequently, operators have been forced to focus primarily on the third option, increasing the capacity of existing systems.

To increase the capacity of existing PCS infra-structure, however, base station technology has evolved in ways that were never anticipated when the power levels were first adopted. As a result, the decade-old rules no longer reflect the way that PCS service is deployed (if they ever did) and thus, they artificially constrain the operators' ability to meet subscriber demand.

Amidst confusion over the terms "base station," "transmitter," "channel," and "carrier," the PCS industry has elected to choose the most sensible interpretation of Section 24.232(a), as clarified in 1994. Except in the very smallest locales, PCS operators have designed their systems on an architecture based on power levels measured on a per carrier basis. This is because operators have found it easier to grow their systems by adding carriers rather than by adding base stations or even antennas. But this means that overall base station power has had to increase to handle the traffic and to eliminate "dead zones" created by tower spacing issues.⁹ Today, there exist thousands of PCS base stations that would not be in compliance with Section 24.232(a) if EIRP or output power were measured on any basis other than per carrier. Powerwave submits that the time has now come for the Commission to accept this simple market reality.

⁹ In many instances, because of local opposition to increasing the number of towers in a community, PCS licensees have had to co-locate on cellular towers which are not spaced for the shorter range PCS resulting in dead zones that can only be covered by boosting power.

Output Power Limits Should be Eliminated in Favor of EIRP limits

Powerwave had advocated the elimination of output power limits due to confusion over how and where such output should be measured, particularly in the case of MCPAs, and because it is a redundant limitation in light of the EIRP requirements in the rules. The first concern, as noted above, is that the rules provide no workable definition of “transmitter” or “channel” against which to measure a base station’s output power. If limits are to apply for each combination of discrete radio plus amplifier, it becomes an arbitrary standard in the context of MCPAs, as Powerwave has already shown.¹⁰ To illustrate, consider a base station comprised of five radios, each powered by a 100 watt SCPA. The current rules treat this configuration as a five “transmitter” base station and thus, allow each radio/SCPA combination to transmit at 100 watts of output power. The same base station, however, re-configured so that all five radios are powered by a single MCPA, would be treated much differently under the rules. Here, the MCPA would be regarded as one “transmitter” limited to a total of 100 watts of power for all five radios. With no technical justification whatsoever, the rules illogically and arbitrarily discriminate against MCPA designs¹¹ --- a particularly troublesome concern when one considers the many advantages which MCPAs have over SCPAs for handling PCS growth.¹²

¹⁰ See Comments of Powerwave Inc. in WT Docket No. 02-310

¹¹ A similar problem exists if “transmitter” limits are imposed based on the number of base station antennas. In such case, a base station which is at the 100 watt per antenna limit could increase capacity only by adding more antennas. In many instances, however, additional antennas are not an option due to physical limitations of the towers or because of legal constraints placed on operators by tower landlords. Thus, increasing the capacity of existing antennas may be the only way to meet subscriber demand. But a per antenna limits forces operators to spread power among a larger pool of users reducing coverage for everyone.

¹² These advantages include: the low power combining of signals which allows for improved cancellation of intermodulation distortion as compared to high power combining designs; improved frequency channel spacing which increase network calling capacity; improved transfer of final transmit power to the antenna;

Powerwave's second concern is that an output power limit is largely redundant given the existence of both an EIRP limit and a boundary (field strength) limit for broadband PCS.¹³ It should be recalled that the only reason an output power limitation was adopted in the first place was to avoid the possibility that powerful base stations might "outrun" the ability of mobiles to respond. Whether such a concern was justified in 1994, it certainly is no longer the case. Mobile radio competition, particularly in the world of number portability, is intense. A PCS provider could not retain customers if its base stations and mobile links were not in balance, and it would be presumptive for anyone to assume that the Commission needs to legislate such balance. It is also instructive that neither the cellular nor the narrowband PCS rules prescribe an output power limitation but instead rely solely (and successfully) on an ERP limit to control in-band emissions. Output power limits play no role in the authorization process for cellular and narrowband PCS equipment (out of band limits do just fine) and thus, there is no reason to assume that such limits are needed for broadband either. Powerwave, therefore, recommends strongly that the Commission eliminate the output power limit in its entirety for broadband PCS.

increased redundancy; flexibility for mixed-mode capability permitting some operators to transfer from one transmission scheme to another (i.e. TDMA to GSM) without replacing power amplifiers; improvement of base station design efficiency; and the elimination of large losses incurred during high power signal combining.

¹³ See Section 24.236.

Defintion of “Carrier”

The Notice requests that parties who favor an output limit on a per carrier basis to provide a definition of the term “carrier” that would be unambiguous for the various types of modulation technologies used by PCS. Powerwave submits that the term “carrier” should be defined as a physical slice of the spectrum over which information is transmitted according to a standard communications protocol. Multiple voice and/or data channels (i.e. traffic channels) are typically encoded onto a single carrier and PCS base stations have the capability of employing a multiplicity of carriers at any given site. The size (bandwidth) and number of carriers available to base station will depend on the protocol chosen; however, there are many considerations that go into the decision on which protocol to use besides number and size of carriers. GSM, TDMA and CDMA protocols use the PCS spectrum differently with each providing a unique mix of economic, technical and regulatory tradoffs and no one factor predominating over the others. Establishing an EIRP limit on a “per carrier” basis would not alter any protocol mix because the concept is both unambiguous and well understood to all PCS licensees irrespective of the protocol used in their systems.

“Per Carrier” Power Limits Will Not Create Compliance Issues

The Notice suggests that a “per carrier” power limit might make it impossible to determine MCPA compliance through the equipment authorization process because no one can know in advance how many carriers an operator might elect to use with such equipment. Accordingly, the Notice asks how difficult or expensive it might be for the carrier to ensure compliance with the rules if a per carrier rule is established.

Powerwave does not believe that a per carrier rule will create new compliance problems for PCS operators or for the Commission. MCPAs will be tested and authorized under the Part 24 technical standards just as they are currently.¹⁴ If output power limits are eliminated as Powerwave recommends, MCPAs will merely be tested and certified to the rated output power. When the MCPA is installed in a base station, the PCS operator will “provision” it -- i.e. set the number of carriers and the gain for each carrier based on expected coverage and traffic projections. EIRP limits will control how a particular MCPA is provisioned and what antenna gain can be used with each carrier. More importantly, once provisioned, the base station will operate at the per carrier power limits set by the operator regardless of how many carriers are active at any given time.¹⁵ Accordingly, the Commission need not be concerned that base stations using MCPAs will require costly monitoring to ensure that “each individual carrier is in compliance with the rules.”

SPD Limits Should Not be Adopted

The Notice asks whether spectral power density limits might be a more equitable way of regulating PCS power and thus, preferable to a “per carrier” approach. Powerwave believes that sudden shift in favor of SPD limits, which are not used in any of the other mobile services, could be seriously disruptive to PCS operators and equipment manufacturers. For instance, without more information it is not clear the extent to which hastily considered SPD limits might necessitate additional and costly base station

¹⁴ See Public Notice of June 2000 re LPA and Base Station Authorizations. The equipment authorization process does not depend on how many carriers an operator might use with an MCPA. Current practice is to require two tone testing to determine compliance with the Commission’s technical standards

¹⁵ MCPAs use an automatic power control feature to ensure that the provisioned gain on any carrier is not exceeded. This is done both for regulatory purposes and to ensure that the carrier does not suffer distortion.

construction whose cost would inevitably be passed on to consumers. Further studies would be needed on such limits and how they might impact current operations and equipment design before they are introduced into an established service like PCS.

Conclusion

It is quite clear that the PCS industry has evolved remarkably well despite the absence of precise definitions in the Part 24 rules. Operators have, for years, been deploying base station technology based on power limits measured on a per carrier basis and it is important that the Commission recognize this fact. Although the emergence of MCPAs served to bring some historic definitional questions to a head, it does not change the fact that per carrier power limits are critical to coping with burgeoning subscriber demand. Accordingly, Powerwave requests that the Commission update its Part 24 rules so that they comport with the realities in today's market.

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