

2007-2008 年手机 射频行业研究报告

Handset RF (Radio Frequency) Industry Report,
2007-2008

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摘要

手机射频部分最关键的元件是收发器和功率放大器。收发器领域厂家分为两大类，一类是依托基频平台，将收发器作为平台的一部分，如德州仪器、高通、NXP、飞思卡尔和联发科。这是因为收发器与基频的关系非常密切，两者通常需要协同设计。另一类是专业的射频厂家，不依靠基频平台来拓展收发器市场，如英飞凌、意法半导体、RFMD 和 SKYWORKS。后一类厂家中英飞凌和意法半导体都是为诺基亚定做收发器，英飞凌还为摩托罗拉和索尼爱立信定做 3G 时代的收发器。意法半导体的手机射频业务则是全部围绕诺基亚展开，没有任何对外销售的产品，只有诺基亚一个客户。英飞凌和意法半导体的收发器业务都严重依赖诺基亚，如果失去诺基亚这个大客户，可以说，意法半导体的收发器业务就宣告倒闭。而 RFMD 和 SKYWORKS 对收发器领域已经失去兴趣，所占的业务量在其总业务量比例很低，特别是 RFMD。以目前的形势看，得不到手机平台的支持，RFMD 和 SKYWORKS 的收发器业务很难维持下去，要么出售，要么关闭。SILABS 就在 2007 年把其收发器业务出售给 NXP，实际 SILABS 的收发器业务作的很优秀，LG、三星和夏新都是其忠实客户。联发科依靠基频，将收发器业务从 2005 年的市场占有率不到 1%，做到目前全球第五，市场占有率超过 12%。

收发器在朝集成化和多模化前进。集成化是因为手机行家对持续降低成本的要求，收发器的半导体制造工艺已经从 2000 年初的 BiCMOS 转换为 RF CMOS，单模的收发器完全集成到基频里。如果手机基频厂家做不到这一点，就很容易在竞争中处于不利地位。英飞凌和博通在这方面做得非常优秀。NXP 买下 SILABS 的收发器业务也是为了弥补自己的这一缺点。多模化则是对厂家能力的挑战，未来的 3G、4G 手机很有可能多模，有 WCDMA、LTE 和 WIMAX，实力不济的厂家将会出局。

那些试图在手机收发器领域开创一片新天地的厂家，我们认为这些厂家不可能成功。这个领域不是新兴厂家和小厂家能够生存的，虽然有可能被大厂并购。不过在大厂并购之前，恐怕就已经花光了所有风险投资者的资金。

功率放大领域则是一个有门槛的独立的领域，也是手机里无法集成化的元件，同时这也是手机中最重要的元件，手机的通话质量、信号接收能力、电池续航能力都由功率放大器决定。一般厂家选定功率放大器之后，更换供应商的可能非常非常小。众多新兴技术厂家试图将功率放大器采用硅基 CMOS 工艺来取代目前 GaAs 基 PHEMT 工艺，这几乎不可能。先不说，厂家对新技术的接受程度，单成本方面 CMOS 也不占优势，因为 CMOS 低的只是晶圆的成本，而总成本根本没有任何优势。虽然购买一片 6 寸 GaAs 晶圆需要美金 500 左右，而 8 英寸硅晶圆的成本还不到 50 美金。但是可以利用一片 6 英寸 GaAs 晶圆上生产 5000~1 万片 PA，单个芯片的成本并没有想象的那么高。只是略微高一丁点。再加上封测和设计的成本，硅基 CMOS 功率放大器的成本肯定比 GaAs 基 PHEMT 工艺的功率放大器成本高不少。与硅相比，GaAs 最大的不同在于电子迁移率，其速度约为前者的 2~6 倍，从而在处理高速高频信号时高出一筹。性能上占据绝对优势。功率放大器领域主要厂家是 RFMD、SKYWORKS、RENESAS、NXP、AVAGO、TRIQUINT、ANADIGICS。

2007 年中国大陆地区因为功率放大器缺货导致联发科的出货量下降；联发科的设计手册推荐使用瑞萨和 RFMD 的功率放大器，瑞萨的功率放大器出货量大增，供不应求。而瑞萨的功率放大器继承自

	<p>日立，其产能一直都没有增加，供需缺口达 40%。由于原材料上涨，功率放大器厂家的议价能力很弱，供不应求时居然还亏损，RFMD 出现了亏损，未来功率放大器非涨价不可。</p> <p>射频收发器领域，诺基亚主要委托意法半导体与英飞凌为其定做。英飞凌负责高端和廉价产品，意法半导体负责中端产品。N 系列绝大多数是英飞凌的收发器，6280、N80、N91、N73、N93、N77 是 PIHI，老产品通常是 HINKUV310A 和 VINKUV314A 两片做收发器，6151、6630、6680、6681、E60、E70、N70、N72、N90、N91。早期产品中 2 系列如 2600、6 系列的 6060、6600 和 6030，分别采用 INFINEON 的 PMB3347、PMB3258、PMB3358、PMB3346。意法半导体中低端产品居多，早期为 HELGO，近期为 ANHEU。5、6、7、8 系列多是意法半导体，5 系列包括 5310、5300、5500。6 系列包括 6101、6230、6670、6260。7 系列有 7200、7710、7250、7260、7360。新产品中 N76、N82、N95 采用意法半导体的产品。功率放大基本上只有 RFMD 一个供应商，SKYWORKS 少量补充。</p> <p>至于摩托罗拉，射频收发器大部分由飞思卡尔提供，少量由 RFMD 提供，这也是 RFMD 射频收发器的最主要客户。功率放大器主要由 RFMD 提供，早期产品由飞思卡尔提供，W 系列廉价产品由 SKYWOKRS 提供</p> <p>索尼爱立信的手机平台相当简单，其基频供应商 90%是德州仪器提供。射频领域，功率放大全部是 Skyworks，早期收发器绝大多数是 ERICSSON 自己开发，后多转为 NXP 为其定做。</p> <p>三星的 CDMA 领域射频收发器基本上由高通包揽，GSM 领域射频收发器基本上由 NXP 包揽，早期产品有少量是 RENESAS 提供。功率放大领域双模的 CDMA 功率放大都是由 AVAGO 的 WS1102 负责。E 系列多使用 SKYWORKS，其余 GSM 产品多使用 TRIQUINT 和 RFMD 的产品。CDMA 产品多使用 ANADIGICS 的产品。</p> <p>对于 LG，GSM 领域内功率放大器多采用 SKYWORKS 的，其次是 RFMD 的。收发器多采用 NXP 的。CDMA 领域，收发器自然都是高通的，功率放大则有 SKYWORKS 和 TRIQUINT。</p> <p>在 CDMA 和 WCDMA 领域，华为、中兴这些大厂的功率放大则比较喜欢选用 ANADIGICS。</p>
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Weaver 结构图

800MHz-100GHz 半导体元件工艺分布

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三星 2001-2007 年手机出货量与年增幅统计与预测

三星 2005 年 1 季度到 2007 年 4 季度每季度手机出货量统计

2006 年 4 季度-2007 年 3 季度三星手机出货地域结构比例

2005 年 1 季度到 2007 年 4 季度三星手机出口平均价格与运营利润率统计

2001-2007 年 LG 手机出货量与年增幅统计及预测

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2006 年 1 季度到 2007 年 4 季度 LG 手机每季度销售额与运营利润统计

LG 手机部门地域收入结构

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SKYWORKS 2002-2007 财年收入与毛利率统计

SKYWORKS 2003-2007 财年核心产品收入统计

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SKYWORKS 2007 财年客户结构比例

SKY74400 内部框架图

意法半导体 2007 年收入结构

意法半导体连续 2005-2007 年 12 季度收入统计

意法半导体 2007 年地区收入结构比例

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意法半导体连续 2003-2005 年 12 季度移动通信领域的收入

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2006 财年 4 季度到 2008 财年 1 季度英飞凌无线部门收入统计

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Silicon Lab 2001-2005 年收入与毛利率统计

RFMD 2001 财年-2008 财年收入与运营利润率统计及预测

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SKYWORKS 4 个生产基地简介
SKYWORKS Helios 射频方案产品一览
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六合万通微电子产品
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源通科技手机无线功率放大器产品

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Title	Handset RF (Radio Frequency) Industry Report, 2007-2008	Pages	160
Price	PDF USD \$ 2,800 Hard Copy USD \$ 2,600	Release Date	Apr/2008
Abstract	<p>The most critical components of handset radio frequency or RF are transceivers and power amplifiers or PA. Transceiver manufacturers are divided into two categories. The producers in the first category rely on baseband platform and regard transceiver as part of the platform, such as TI, Qualcomm, NXP, Freescale and MediaTek, because transceiver and baseband have a close relationship and both often require collaboration in their design. The producers in the second category are professional RF manufacturers that do not depend on baseband platform to expand the transceiver market, including Infineon, ST, RFMD and SKYWORKS. Among these producers, Infineon and ST all produce transceivers for Nokia, while Infineon also manufactures 3G-handset transceivers for Motorola and Sony Ericsson. ST only produces handset RF products to Nokia and do not sell its handset RF products to other handset producers, making its transceiver businesses rely completely on the big customer of Nokia. Therefore, if ST loses the big client of Nokia, it will have to shut down its transceiver plant. RFMD and SKYWORKS both have lost interest in transceiver business, the ratio of transceiver business to their total is low, especially that of RFMD. From the perspective of the current situation, it will be very hard for RFMD and SKYWORKS to keep their transceiver business without the support of mobile phone platform, so they will have to either sell it or shut it down. SILABS sold its transceiver business to NXP in 2007. In fact, SILABS transceiver business with LG, Samsung and Amoi as its loyal clients was excellent. By relying on baseband, MediaTek has expanded its global market share of transceiver from less than one percent in 2005 to the current more than 12 percent, ranking the fifth in the world.</p>		

Transceivers are advancing towards integration and multi-mode. Integration is the requirement of handset manufacturers for decreasing the cost continuously. The semiconductor manufacturing technique of transceivers has changed from BiCMOS in early 2000 to the current RF CMOS. The single-mode transceiver is completely integrated into the baseband. If handset baseband manufacturers can not make it, they will easily become disadvantageous in the competition. Infineon and Broadcom have excellent performance in this aspect. The reason why NXP acquired the transceiver business of SILABS is to make up for its shortcoming in this aspect. Multi-mode is a challenge to manufacturers. In the future, mobile phone producers are most likely to adopt multimode, such as WCDMA, LET and WIMAX, in their 3G and 4G mobile phones. Mobile phone producers with poor technological strength will be driven out of the market.

We believe that manufacturers that are making attempts to make a foray into the handset transceiver field cannot succeed, because it is not a field, where emerging producers and small manufacturers can survive. Although they have the chance to be taken over by big manufacturers, they will have used up funds of venture capitalists before being merged.

Power amplifier is an independent field with market entry threshold. PA, as the most important component of a mobile phone, can not be integrated. Handset's call quality, signal receiving ability and battery life are all decided by PA. Generally speaking, once a handset manufacturer chooses a PA supplier, it is almost not possible for the manufacture to change the supplier. Many emerging producers are trying to replace the current PA with GaAs-based PHEMT technique by one with silicon-based CMOS technology, which is nearly impossible. No matter how much manufacturers can accept the new technology, CMOS technology does not have the advantage in cost. Because CMOS technology is only lower in wafer cost, its total cost is not advantageous at all. The purchase cost of one 6-inch GaAs wafer is around US\$500, while that of one 8-inch silicon wafer is less than US\$50. However, one 6-inch GaAs wafer can produce 5,000 to 10,000 PA, so averagely, the cost per chip is not that high as imagined, just a tiny higher. If the cost of IC packaging & testing and design is added, the total cost of silicon-based CMOS PA will be surely a lot higher than that of GaAs-based PHEMT PA. The biggest difference between GaAs and silicon lies in electron mobility. The speed of GaAs electron mobility is two to six times of that of silicon, so its ability of processing high-speed and high-frequency signals is higher, thus making its performance in a dominant position. The main PA manufacturers are RFMD, SKYWORKS, RENESAS, NXP, AVAGO, TRIQUINT, and ANADIGICS.

In 2007, Media Tek shipment in Mainland China decreased, due to the short supply of PA. The design manual of MediaTek recommended handset manufacturers to adopt the power amplifiers of Reneseas and RFMD. Consequently, the PA shipment of Reneseas increased largely and its supply could not meet the demand. The PA business of RENESEAS originated from Hitachi and its production capacity has not risen since then, leading to a 40-percent-gap between supply and demand. Rises in raw material price and quite limited bargaining power have made PA producers even operate at a loss in a PA market with short supply. RFMD is making loss. Therefore, PA price will inevitably rise in the future

	<p>Nokia mainly entrusts ST and Infineon to manufacture RF transceivers. Infineon is in charge of the production of high-end and low-end products, while ST is responsible for the production of mid-end products. Nokia N-series handsets mainly adopt the transceivers of Infineon, for example, 6280, N80, N73, N93, and N77 adopts PIHI, while Nokia old products like 6151, 6630, 6680, 6681, E60, E70, N70, N72, N90 and N91 generally adopt transceivers made of HINKUV310A and VINKUV314A. Nokia in its early products, such 2 series products as 2600, 6060, 6600 and 6030 adopted PMB3347, PMB3258, PMB3358 and PMB3346 of Infineon respectively. ST mainly provides Nokia with transceivers for medium- and low-end products, HELGO in its early products, and ANHEU later. In most of its 5 series, 6 series, 7 series and 8 series handsets, Nokia adopt transceivers of ST. Among its new products like N76, N82 and N95, Nokia adopts the transceivers of ST. Regarding PA, Nokia basically adopts the products of RFMD and only uses a few power amplifiers from SKYWORKS as a supplement.</p> <p>Motorola mainly uses RF transceivers from Freescale and only a few products from RFMD, which still makes Motorola the biggest client of RFMD RF transceivers. Motorola mainly adopts power amplifiers from RFMD, but in its early handsets, the power amplifiers were supplied by Freescale. Power amplifiers in low-end Motorola W-series handsets are supplied by SKYWORKS.</p> <p>Sony Ericsson handsets' basebands are quite simple. 90 percent of its basebands are supplied by TI. About RF, it only adopts SKYWORKS power amplifiers. Transceivers in its early products were developed itself by Ericsson and later it designated NXP to manufacture transceivers.</p> <p>Samsung adopts RF transceivers from Qualcomm in its CDMA handsets and use RF transceivers from NXP in its GSM handsets. In its early products, Samsung used a few RF transceivers from RENESAS. As for PA, dual-mode CDMA power amplifiers of Samsung are WS1102 of AVAGO. Samsung E-series products often adopt SKYWORKS power amplifiers, and its GSM handsets mostly adopt power amplifiers of TRIQUINT and RFMD, while its CDMA products mostly adopt ANADIGICS power amplifiers.</p> <p>In its GSM handsets, LG mostly adopts power amplifiers of SKYWORKS, followed by that of RFMD and mostly adopts transceivers from NXP. In its CDMA handsets, LG adopts transceivers from Qualcomm and power amplifiers from SKYWORKS and TRIQUINT.</p> <p>In their CDMA and WCDMA handsets, big manufacturers, including Huawei and ZTE, prefer to adopt ANADIGICS power amplifiers.</p>
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