CONTRACT MANUFACTURING OPPORTUNITIES IN PRINTED ELECTRONICS

2013 EDITION

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Chapter 1 Introduction

1.1 Report Objectives and Scope

The objective of this report is to provide a macroeconomic understanding of the printed electronics (PE) market to interested equipment suppliers, materials and component companies, and solution/integration firms and electronics manufacturing service (EMS) firms worldwide.

This report is the latest effort to quantify the size of the PE market and the growth of emerging applications. In the past, this subject has been over-hyped and badly forecast despite its potential for replacing traditional electronics manufacturing. NVR has been tracking the PE market since 2007 and the electronics manufacturing services market since 1993. Consequently, we are in a strong position to understand how disruptive technologies can be as they begin to displace or replace traditional semiconductor electronics.

This latest report examines the PE market in over 40 product application areas, and forecasts the demand in real terms using 5-year forecasts. NVR tracks the PE and EMS markets with historic data, thus providing an analog for corroborating the most promising opportunites with emerging applications. While some applications are projected with a growth rate of in excess 100% CAGR (compound annual growth rate), others will expand only at 5% CAGR. The details can be found in this report.

For the last twenty years, the generic term “contract manufacturing” has been identified almost entirely with a very specific niche within the overall durable goods market—that of electronics equipment. This is ironic, as the notion of “contract manufacturing” could be applied to any industry segment (aerospace, appliances, automotive, construction, etc.) that manufactures finished goods, yet over the last few years it has been exclusively linked to the electronics—specifically the high-tech electronics—market segment. As the electronics manufacturing industry has evolved over the years, the term “electronics manufacturing services (EMS)” has come to refer both to the overall industry and a specific class of subcontractor.

The current report summarizes the entire CM electronics assembly market, but pays special attention to the production of advanced, state-of-the-art PE technologies which are having considerable impact on the world today. Not all application areas are equal in potential, but because of our long history in tracking the manufacturing cost of goods sold (COGS), our knowledge database and

experience provide us with the best analysis in comparing and projecting the PE products with the most potential. It is probably fair to say that these products would not be so widespread were it not for the emergence of the EMS industry, which has lowered product costs and increased manufacturing efficiency.

1.2 Organization

This report is organized into seven chapters. Chapter 1, "Introduction," outlines the scope, organization, and methodology for the report. Chapter 2, "Executive Summary," presents top-level data from throughout the report.

Chapter 3, titled "Printed Electronics Technology," examines organic electronics and thin film materials, and PE manufacturing equipment by technology.

Chapter 4, "Printed Electronics Materials Market," analyzes conductive inks, conductive films, microcapsules, organic/inorganic transistors/polymers, and nanoparticles.

Chapter 5, "Printed Electronics Market Application," examines key products by leading market segments, including consumer electronics, medical, packaging, transportation (automotive and aerospace/defense), and other general applications that includes batteries, memory/logic and sensors.

Chapter 6, "Printed Electronics Market Forecasts," examines over 40 different PE applications and estimates their growth over the next five years. The highest growth markets are projected to expand over 125% CAGR, while others are as low as only 5% CAGR. Overall, the market for PE products is expected to almost triple over the next five years, achieving nearly $10 billion in 2017.

Chapter 7, "Company Profiles," analyzes the leading PE companies and suppliers by three dimensions – printing equipment (plus manufacturing production technology), advanced materials that provide thin film solutions, and the many solution/application providers who either develop technical solutions or successfully integrate one or more PE technologies. In all, 185 PE companies are profiled in this report and organized according to industry solution.

1.3 Assumptions

The following assumptions have been made with regard to information provided in this report:

- Respondents are providing truthful information to the best of their ability.

- Values are mainly provided in current US dollars.
- Revenues are converted from national currencies into US dollars by using the current Federal Reserve average annual rates.
- Wage rates were not adjusted to reflect the appreciation of the euro or the undervaluation of the Chinese yuan.
- All tables presented in this report are subject to small rounding errors. Therefore, column and row numbers, as presented, may not add up exactly to the total presented.

1.4 Definitions

Several critical terms will be used frequently in this report. They are:

- *PCB Assembly*: For this report, PCB assembly refers to the attachment of various electronic components onto a bare printed circuit board, plus any test activities performed at this level of assembly.
- *PCB Assembly Value*: The value (cost of goods sold, or COGS) of all material, labor, and overhead associated with an assembled printed circuit board.
- *OEM Assembly*: Electronics assembly performed by the OEM. If assembly is performed by a subcontractor that is held captive by the OEM or in a *keiretsu* arrangement such as exists in Japan, the assembly is considered OEM produced.

1.5 Research Methodology

Information for this report was collected from a number of external sources. Primary sources include direct interviews with marketing professionals, and with manufacturing and engineering directors in contract manufacturing firms. In many cases we have quoted individuals directly but there are also cases where information has not been quoted but integrated into our research findings.

Some individuals and companies were particularly helpful in taking the time to speak with us and provide supporting materials. They include the following (alphabetically by company): Kevin Chen and Eileen Tanghal, Applied Materials; Wayne Baker, Checkpoint Systems; Don Banfield, Conductive Compounds; Len Allison, Conductive Materials; Sriram Peruvemba, E Ink; Darrell Etter and Tim Luong, Fuji Dimatix; Gordon Smith, GSI Tehnologies; Steve Gilberton, Kammann; David Fyfe, Liquid X Printed

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