

# 2018-2023 Global Ferroelectric RAM Consumption Market Report

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## Abstracts

The report requires updating with new data and is sent in 48 hours after order is placed.

In this report, LP Information covers the present scenario (with the base year being 2017) and the growth prospects of global Ferroelectric RAM market for 2018-2023.

Ferroelectric RAM (FeRAM, F-RAM or FRAM) is a random-access memory similar in construction to DRAM but utilizing a ferroelectric layer instead of a dielectric layer to achieve non-volatility. FeRAM is one of a growing number of alternative non-volatile random-access memory technologies which can offer that same functionality as flash memory.

FeRAM consists of a grid of small capacitors and associated wiring and signaling transistors. Each storage element, a cell, consists of one capacitor and one transistor. Unlike the DRAM use a linear dielectric in its cell capacitor, dielectric structure in the FeRAM cell capacitor usually contains ferroelectric material, typically lead zirconate titanate (PZT).

A ferroelectric material has a nonlinear relationship between the applied electric field and the apparent stored charge. The ferroelectric characteristic has the form of a hysteresis loop, which is very similar in shape to the hysteresis loop of ferromagnetic materials. The dielectric constant of a ferroelectric is typically much higher than that of a linear dielectric because of the effects of semi-permanent electric dipoles formed in the crystal structure of the ferroelectric material. When an external electric field is applied across a dielectric, the dipoles tend to align themselves with the field direction, produced by small shifts in the positions of atoms and shifts in the distributions of electronic charge in the crystal structure. After the charge is removed, the dipoles retain

their polarization state. Binary "0"s and "1"s are stored as one of two possible electric polarizations in each data storage cell. For example, in the figure a "1" is encoded using the negative remnant polarization "-Pr", and a "0" is encoded using the positive remnant polarization "+Pr". In terms of operation, FeRAM is similar to DRAM. Writing is accomplished by applying a field across the ferroelectric layer by charging the plates on either side of it, forcing the atoms inside into the "up" or "down" orientation (depending on the polarity of the charge), thereby storing a "1" or "0". Reading, however, is somewhat different than in DRAM. The transistor forces the cell into a particular state, say "0". If the cell already held a "0", nothing will happen in the output lines. If the cell held a "1", the re-orientation of the atoms in the film will cause a brief pulse of current in the output as they push electrons out of the metal on the "down" side. The presence of this pulse means the cell held a "1". Since this process overwrites the cell, reading FeRAM is a destructive process, and requires the cell to be re-written if it was changed.

Ferroelectric RAM was proposed by MIT graduate student Dudley Allen Buck in his master's thesis, *Ferroelectrics for Digital Information Storage and Switching*, published in 1952. Development of FeRAM began in the late 1980s. Work was done in 1991 at NASA's Jet Propulsion Laboratory on improving methods of read out, including a novel method of non-destructive readout using pulses of UV radiation. Much of the current FeRAM technology was developed by Ramtron, a fabless semiconductor company. One major licensee is Fujitsu, who operates what is probably the largest semiconductor foundry production line with FeRAM capability. Since 1999 they have been using this line to produce standalone FeRAMs, as well as specialized chips (e.g. chips for smart cards) with embedded FeRAMs. Fujitsu produced devices for Ramtron until 2010. Since 2010 Ramtron's fabricators have been TI (Texas Instruments) and IBM. Since at least 2001 Texas Instruments has collaborated with Ramtron to develop FeRAM test chips in a modified 130 nm process. In the fall of 2005, Ramtron reported that they were evaluating prototype samples of an 8-megabit FeRAM manufactured using Texas Instruments' FeRAM process. Fujitsu and Seiko-Epson were in 2005 collaborating in the development of a 180 nm FeRAM process. In 2012 Ramtron was acquired by Cypress Semiconductor. FeRAM research projects have also been reported at Samsung, Matsushita, Oki, Toshiba, Infineon, Hynix, Symetrix, Cambridge University, University of Toronto, and the Interuniversity Microelectronics Centre (IMEC, Belgium).

Over the next five years, LPI(LP Information) projects that Ferroelectric RAM will register a 3.7% CAGR in terms of revenue, reach US\$ 300 million by 2023, from US\$ 240 million in 2017.

This report presents a comprehensive overview, market shares, and growth

opportunities of Ferroelectric RAM market by product type, application, key manufacturers and key regions.

To calculate the market size, LP Information considers value and volume generated from the sales of the following segments:

Segmentation by product type:

Serial Memory

Parallel Memory

Others

Segmentation by application:

Smart Meters

Automotive Electronics

Medical Devices

Wearable Devices

This report also splits the market by region:

Americas

United States

Canada

Mexico

Brazil

APAC

China

Japan

Korea

Southeast Asia

India

Australia

Europe

Germany

France

UK

Italy

Russia

Spain

Middle East & Africa

Egypt

South Africa

Israel

Turkey

GCC Countries

The report also presents the market competition landscape and a corresponding detailed analysis of the major vendor/manufacturers in the market. The key manufacturers covered in this report:

Cypress Semiconductor

Fujitsu

Texas Instruments

IBM

Infineon

...

In addition, this report discusses the key drivers influencing market growth, opportunities, the challenges and the risks faced by key manufacturers and the market as a whole. It also analyzes key emerging trends and their impact on present and future development.

#### Research objectives

To study and analyze the global Ferroelectric RAM consumption (value & volume) by key regions/countries, product type and application, history data from 2013 to 2017, and forecast to 2023.

To understand the structure of Ferroelectric RAM market by identifying its various subsegments.

Focuses on the key global Ferroelectric RAM manufacturers, to define, describe and analyze the sales volume, value, market share, market competition landscape, SWOT analysis and development plans in next few years.

To analyze the Ferroelectric RAM with respect to individual growth trends, future prospects, and their contribution to the total market.

To share detailed information about the key factors influencing the growth of the

market (growth potential, opportunities, drivers, industry-specific challenges and risks).

To project the consumption of Ferroelectric RAM submarkets, with respect to key regions (along with their respective key countries).

To analyze competitive developments such as expansions, agreements, new product launches, and acquisitions in the market.

To strategically profile the key players and comprehensively analyze their growth strategies.

## Contents

### 1 SCOPE OF THE REPORT

- 1.1 Market Introduction
- 1.2 Research Objectives
- 1.3 Years Considered
- 1.4 Market Research Methodology
- 1.5 Economic Indicators
- 1.6 Currency Considered

### 2 EXECUTIVE SUMMARY

- 2.1 World Market Overview
  - 2.1.1 Global Ferroelectric RAM Consumption 2013-2023
  - 2.1.2 Ferroelectric RAM Consumption CAGR by Region
- 2.2 Ferroelectric RAM Segment by Type
  - 2.2.1 Serial Memory
  - 2.2.2 Parallel Memory
  - 2.2.3 Others
- 2.3 Ferroelectric RAM Consumption by Type
  - 2.3.1 Global Ferroelectric RAM Consumption Market Share by Type (2013-2018)
  - 2.3.2 Global Ferroelectric RAM Revenue and Market Share by Type (2013-2018)
  - 2.3.3 Global Ferroelectric RAM Sale Price by Type (2013-2018)
- 2.4 Ferroelectric RAM Segment by Application
  - 2.4.1 Smart Meters
  - 2.4.2 Automotive Electronics
  - 2.4.3 Medical Devices
  - 2.4.4 Wearable Devices
- 2.5 Ferroelectric RAM Consumption by Application
  - 2.5.1 Global Ferroelectric RAM Consumption Market Share by Application (2013-2018)
  - 2.5.2 Global Ferroelectric RAM Value and Market Share by Application (2013-2018)
  - 2.5.3 Global Ferroelectric RAM Sale Price by Application (2013-2018)

### 3 GLOBAL FERROELECTRIC RAM BY PLAYERS

- 3.1 Global Ferroelectric RAM Sales Market Share by Players
  - 3.1.1 Global Ferroelectric RAM Sales by Players (2016-2018)
  - 3.1.2 Global Ferroelectric RAM Sales Market Share by Players (2016-2018)

### 3.2 Global Ferroelectric RAM Revenue Market Share by Players

#### 3.2.1 Global Ferroelectric RAM Revenue by Players (2016-2018)

#### 3.2.2 Global Ferroelectric RAM Revenue Market Share by Players (2016-2018)

### 3.3 Global Ferroelectric RAM Sale Price by Players

### 3.4 Global Ferroelectric RAM Manufacturing Base Distribution, Sales Area, Product Types by Players

#### 3.4.1 Global Ferroelectric RAM Manufacturing Base Distribution and Sales Area by Players

#### 3.4.2 Players Ferroelectric RAM Products Offered

### 3.5 Market Concentration Rate Analysis

#### 3.5.1 Competition Landscape Analysis

#### 3.5.2 Concentration Ratio (CR3, CR5 and CR10) (2016-2018)

### 3.6 New Products and Potential Entrants

### 3.7 Mergers & Acquisitions, Expansion

## 4 FERROELECTRIC RAM BY REGIONS

### 4.1 Ferroelectric RAM by Regions

#### 4.1.1 Global Ferroelectric RAM Consumption by Regions

#### 4.1.2 Global Ferroelectric RAM Value by Regions

### 4.2 Americas Ferroelectric RAM Consumption Growth

### 4.3 APAC Ferroelectric RAM Consumption Growth

### 4.4 Europe Ferroelectric RAM Consumption Growth

### 4.5 Middle East & Africa Ferroelectric RAM Consumption Growth

## 5 AMERICAS

### 5.1 Americas Ferroelectric RAM Consumption by Countries

#### 5.1.1 Americas Ferroelectric RAM Consumption by Countries (2013-2018)

#### 5.1.2 Americas Ferroelectric RAM Value by Countries (2013-2018)

### 5.2 Americas Ferroelectric RAM Consumption by Type

### 5.3 Americas Ferroelectric RAM Consumption by Application

### 5.4 United States

### 5.5 Canada

### 5.6 Mexico

### 5.7 Key Economic Indicators of Few Americas Countries

## 6 APAC



## 6.1 APAC Ferroelectric RAM Consumption by Countries

### 6.1.1 APAC Ferroelectric RAM Consumption by Countries (2013-2018)

### 6.1.2 APAC Ferroelectric RAM Value by Countries (2013-2018)

## 6.2 APAC Ferroelectric RAM Consumption by Type

## 6.3 APAC Ferroelectric RAM Consumption by Application

## 6.4 China

## 6.5 Japan

## 6.6 Korea

## 6.7 Southeast Asia

## 6.8 India

## 6.9 Australia

## 6.10 Key Economic Indicators of Few APAC Countries

# 7 EUROPE

## 7.1 Europe Ferroelectric RAM by Countries

### 7.1.1 Europe Ferroelectric RAM Consumption by Countries (2013-2018)

### 7.1.2 Europe Ferroelectric RAM Value by Countries (2013-2018)

## 7.2 Europe Ferroelectric RAM Consumption by Type

## 7.3 Europe Ferroelectric RAM Consumption by Application

## 7.4 Germany

## 7.5 France

## 7.6 UK

## 7.7 Italy

## 7.8 Russia

## 7.9 Spain

## 7.10 Key Economic Indicators of Few Europe Countries

# 8 MIDDLE EAST & AFRICA

## 8.1 Middle East & Africa Ferroelectric RAM by Countries

### 8.1.1 Middle East & Africa Ferroelectric RAM Consumption by Countries (2013-2018)

### 8.1.2 Middle East & Africa Ferroelectric RAM Value by Countries (2013-2018)

## 8.2 Middle East & Africa Ferroelectric RAM Consumption by Type

## 8.3 Middle East & Africa Ferroelectric RAM Consumption by Application

## 8.4 Egypt

## 8.5 South Africa

## 8.6 Israel

## 8.7 Turkey

## 8.8 GCC Countries

# 9 MARKET DRIVERS, CHALLENGES AND TRENDS

## 9.1 Market Drivers and Impact

### 9.1.1 Growing Demand from Key Regions

### 9.1.2 Growing Demand from Key Applications and Potential Industries

## 9.2 Market Challenges and Impact

## 9.3 Market Trends

# 10 MARKETING, DISTRIBUTORS AND CUSTOMER

## 10.1 Sales Channel

### 10.1.1 Direct Marketing

### 10.1.2 Indirect Marketing

## 10.2 Ferroelectric RAM Distributors

## 10.3 Ferroelectric RAM Customer

# 11 GLOBAL FERROELECTRIC RAM MARKET FORECAST

## 11.1 Global Ferroelectric RAM Consumption Forecast (2018-2023)

## 11.2 Global Ferroelectric RAM Forecast by Regions

### 11.2.1 Global Ferroelectric RAM Forecast by Regions (2018-2023)

### 11.2.2 Global Ferroelectric RAM Value Forecast by Regions (2018-2023)

### 11.2.3 Americas Consumption Forecast

### 11.2.4 APAC Consumption Forecast

### 11.2.5 Europe Consumption Forecast

### 11.2.6 Middle East & Africa Consumption Forecast

## 11.3 Americas Forecast by Countries

### 11.3.1 United States Market Forecast

### 11.3.2 Canada Market Forecast

### 11.3.3 Mexico Market Forecast

### 11.3.4 Brazil Market Forecast

## 11.4 APAC Forecast by Countries

### 11.4.1 China Market Forecast

### 11.4.2 Japan Market Forecast

### 11.4.3 Korea Market Forecast

### 11.4.4 Southeast Asia Market Forecast

### 11.4.5 India Market Forecast

- 11.4.6 Australia Market Forecast
- 11.5 Europe Forecast by Countries
  - 11.5.1 Germany Market Forecast
  - 11.5.2 France Market Forecast
  - 11.5.3 UK Market Forecast
  - 11.5.4 Italy Market Forecast
  - 11.5.5 Russia Market Forecast
  - 11.5.6 Spain Market Forecast
- 11.6 Middle East & Africa Forecast by Countries
  - 11.6.1 Egypt Market Forecast
  - 11.6.2 South Africa Market Forecast
  - 11.6.3 Israel Market Forecast
  - 11.6.4 Turkey Market Forecast
  - 11.6.5 GCC Countries Market Forecast
- 11.7 Global Ferroelectric RAM Forecast by Type
- 11.8 Global Ferroelectric RAM Forecast by Application

## **12 KEY PLAYERS ANALYSIS**

- 12.1 Cypress Semiconductor
  - 12.1.1 Company Details
  - 12.1.2 Ferroelectric RAM Product Offered
  - 12.1.3 Cypress Semiconductor Ferroelectric RAM Sales, Revenue, Price and Gross Margin (2016-2018)
  - 12.1.4 Main Business Overview
  - 12.1.5 Cypress Semiconductor News
- 12.2 Fujitsu
  - 12.2.1 Company Details
  - 12.2.2 Ferroelectric RAM Product Offered
  - 12.2.3 Fujitsu Ferroelectric RAM Sales, Revenue, Price and Gross Margin (2016-2018)
  - 12.2.4 Main Business Overview
  - 12.2.5 Fujitsu News
- 12.3 Texas Instruments
  - 12.3.1 Company Details
  - 12.3.2 Ferroelectric RAM Product Offered
  - 12.3.3 Texas Instruments Ferroelectric RAM Sales, Revenue, Price and Gross Margin (2016-2018)
  - 12.3.4 Main Business Overview

12.3.5 Texas Instruments News

## 12.4 IBM

12.4.1 Company Details

12.4.2 Ferroelectric RAM Product Offered

12.4.3 IBM Ferroelectric RAM Sales, Revenue, Price and Gross Margin (2016-2018)

12.4.4 Main Business Overview

12.4.5 IBM News

## 12.5 Infineon

12.5.1 Company Details

12.5.2 Ferroelectric RAM Product Offered

12.5.3 Infineon Ferroelectric RAM Sales, Revenue, Price and Gross Margin  
(2016-2018)

12.5.4 Main Business Overview

12.5.5 Infineon News

...

## 13 RESEARCH FINDINGS AND CONCLUSION

## List Of Tables

### LIST OF TABLES AND FIGURES

Figure Picture of Ferroelectric RAM

Table Product Specifications of Ferroelectric RAM

Figure Ferroelectric RAM Report Years Considered

Figure Market Research Methodology

Figure Global Ferroelectric RAM Consumption Growth Rate 2013-2023 (M Units)

Figure Global Ferroelectric RAM Value Growth Rate 2013-2023 (\$ Millions)

Table Ferroelectric RAM Consumption CAGR by Region 2013-2023 (\$ Millions)

Figure Product Picture of Serial Memory

Table Major Players of Serial Memory

Figure Product Picture of Parallel Memory

Table Major Players of Parallel Memory

Figure Product Picture of Others

Table Major Players of Others

Table Global Consumption Sales by Type (2013-2018)

Table Global Ferroelectric RAM Consumption Market Share by Type (2013-2018)

Figure Global Ferroelectric RAM Consumption Market Share by Type (2013-2018)

Table Global Ferroelectric RAM Revenue by Type (2013-2018) (\$ million)

Table Global Ferroelectric RAM Value Market Share by Type (2013-2018) (\$ Millions)

Figure Global Ferroelectric RAM Value Market Share by Type (2013-2018)

Table Global Ferroelectric RAM Sale Price by Type (2013-2018)

Figure Ferroelectric RAM Consumed in Smart Meters

Figure Global Ferroelectric RAM Market: Smart Meters (2013-2018) (M Units)

Figure Global Ferroelectric RAM Market: Smart Meters (2013-2018) (\$ Millions)

Figure Global Smart Meters YoY Growth (\$ Millions)

Figure Ferroelectric RAM Consumed in Automotive Electronics

Figure Global Ferroelectric RAM Market: Automotive Electronics (2013-2018) (M Units)

Figure Global Ferroelectric RAM Market: Automotive Electronics (2013-2018) (\$ Millions)

Figure Global Automotive Electronics YoY Growth (\$ Millions)

Figure Ferroelectric RAM Consumed in Medical Devices

Figure Global Ferroelectric RAM Market: Medical Devices (2013-2018) (M Units)

Figure Global Ferroelectric RAM Market: Medical Devices (2013-2018) (\$ Millions)

Figure Global Medical Devices YoY Growth (\$ Millions)

Figure Ferroelectric RAM Consumed in Wearable Devices

Figure Global Ferroelectric RAM Market: Wearable Devices (2013-2018) (M Units)

Figure Global Ferroelectric RAM Market: Wearable Devices (2013-2018) (\$ Millions)

Figure Global Wearable Devices YoY Growth (\$ Millions)

Table Global Consumption Sales by Application (2013-2018)

Table Global Ferroelectric RAM Consumption Market Share by Application (2013-2018)

Figure Global Ferroelectric RAM Consumption Market Share by Application (2013-2018)

Table Global Ferroelectric RAM Value by Application (2013-2018)

Table Global Ferroelectric RAM Value Market Share by Application (2013-2018)

Figure Global Ferroelectric RAM Value Market Share by Application (2013-2018)

Table Global Ferroelectric RAM Sale Price by Application (2013-2018)

Table Global Ferroelectric RAM Sales by Players (2016-2018) (M Units)

Table Global Ferroelectric RAM Sales Market Share by Players (2016-2018)

Figure Global Ferroelectric RAM Sales Market Share by Players in 2016

Figure Global Ferroelectric RAM Sales Market Share by Players in 2017

Table Global Ferroelectric RAM Revenue by Players (2016-2018) (\$ Millions)

Table Global Ferroelectric RAM Revenue Market Share by Players (2016-2018)

Figure Global Ferroelectric RAM Revenue Market Share by Players in 2016

Figure Global Ferroelectric RAM Revenue Market Share by Players in 2017

Table Global Ferroelectric RAM Sale Price by Players (2016-2018)

Figure Global Ferroelectric RAM Sale Price by Players in 2017

Table Global Ferroelectric RAM Manufacturing Base Distribution and Sales Area by Players

Table Players Ferroelectric RAM Products Offered

Table Ferroelectric RAM Concentration Ratio (CR3, CR5 and CR10) (2016-2018)

Table Global Ferroelectric RAM Consumption by Regions 2013-2018 (M Units)

Table Global Ferroelectric RAM Consumption Market Share by Regions 2013-2018

Figure Global Ferroelectric RAM Consumption Market Share by Regions 2013-2018

Table Global Ferroelectric RAM Value by Regions 2013-2018 (\$ Millions)

Table Global Ferroelectric RAM Value Market Share by Regions 2013-2018

Figure Global Ferroelectric RAM Value Market Share by Regions 2013-2018

Figure Americas Ferroelectric RAM Consumption 2013-2018 (M Units)

Figure Americas Ferroelectric RAM Value 2013-2018 (\$ Millions)

Figure APAC Ferroelectric RAM Consumption 2013-2018 (M Units)

Figure APAC Ferroelectric RAM Value 2013-2018 (\$ Millions)

Figure Europe Ferroelectric RAM Consumption 2013-2018 (M Units)

Figure Europe Ferroelectric RAM Value 2013-2018 (\$ Millions)

Figure Middle East & Africa Ferroelectric RAM Consumption 2013-2018 (M Units)

Figure Middle East & Africa Ferroelectric RAM Value 2013-2018 (\$ Millions)

Table Americas Ferroelectric RAM Consumption by Countries (2013-2018) (M Units)



Table Americas Ferroelectric RAM Consumption Market Share by Countries  
(2013-2018)

Figure Americas Ferroelectric RAM Consumption Market Share by Countries in 2017

Table Americas Ferroelectric RAM Value by Countries (2013-2018) (\$ Millions)

Table Americas Ferroelectric RAM Value Market Share by Countries (2013-2018)

Figure Americas Ferroelectric RAM Value Market Share by Countries in 2017

Table Americas Ferroelectric RAM Consumption by Type (2013-2018) (M Units)

Table Americas Ferroelectric RAM Consumption Market Share by Type (2013-2018)

Figure Americas Ferroelectric RAM Consumption Market Share by Type in 2017

Table Americas Ferroelectric RAM Consumption by Application (2013-2018) (M Units)

Table Americas Ferroelectric RAM Consumption Market Share by Application  
(2013-2018)

Figure Americas Ferroelectric RAM Consumption Market Share by Application in 2017

Figure United States Ferroelectric RAM Consumption Growth 2013-2018 (M Units)

Figure United States Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)

Figure Canada Ferroelectric RAM Consumption Growth 2013-2018 (M Units)

Figure Canada Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)

Figure Mexico Ferroelectric RAM Consumption Growth 2013-2018 (M Units)

Figure Mexico Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)

Table APAC Ferroelectric RAM Consumption by Countries (2013-2018) (M Units)

Table APAC Ferroelectric RAM Consumption Market Share by Countries (2013-2018)

Figure APAC Ferroelectric RAM Consumption Market Share by Countries in 2017

Table APAC Ferroelectric RAM Value by Countries (2013-2018) (\$ Millions)

Table APAC Ferroelectric RAM Value Market Share by Countries (2013-2018)

Figure APAC Ferroelectric RAM Value Market Share by Countries in 2017

Table APAC Ferroelectric RAM Consumption by Type (2013-2018) (M Units)

Table APAC Ferroelectric RAM Consumption Market Share by Type (2013-2018)

Figure APAC Ferroelectric RAM Consumption Market Share by Type in 2017

Table APAC Ferroelectric RAM Consumption by Application (2013-2018) (M Units)

Table APAC Ferroelectric RAM Consumption Market Share by Application (2013-2018)

Figure APAC Ferroelectric RAM Consumption Market Share by Application in 2017

Figure China Ferroelectric RAM Consumption Growth 2013-2018 (M Units)

Figure China Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)

Figure Japan Ferroelectric RAM Consumption Growth 2013-2018 (M Units)

Figure Japan Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)

Figure Korea Ferroelectric RAM Consumption Growth 2013-2018 (M Units)

Figure Korea Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)

Figure Southeast Asia Ferroelectric RAM Consumption Growth 2013-2018 (M Units)

Figure Southeast Asia Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)

Figure India Ferroelectric RAM Consumption Growth 2013-2018 (M Units)  
Figure India Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)  
Figure Australia Ferroelectric RAM Consumption Growth 2013-2018 (M Units)  
Figure Australia Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)  
Table Europe Ferroelectric RAM Consumption by Countries (2013-2018) (M Units)  
Table Europe Ferroelectric RAM Consumption Market Share by Countries (2013-2018)  
Figure Europe Ferroelectric RAM Consumption Market Share by Countries in 2017  
Table Europe Ferroelectric RAM Value by Countries (2013-2018) (\$ Millions)  
Table Europe Ferroelectric RAM Value Market Share by Countries (2013-2018)  
Figure Europe Ferroelectric RAM Value Market Share by Countries in 2017  
Table Europe Ferroelectric RAM Consumption by Type (2013-2018) (M Units)  
Table Europe Ferroelectric RAM Consumption Market Share by Type (2013-2018)  
Figure Europe Ferroelectric RAM Consumption Market Share by Type in 2017  
Table Europe Ferroelectric RAM Consumption by Application (2013-2018) (M Units)  
Table Europe Ferroelectric RAM Consumption Market Share by Application (2013-2018)  
Figure Europe Ferroelectric RAM Consumption Market Share by Application in 2017  
Figure Germany Ferroelectric RAM Consumption Growth 2013-2018 (M Units)  
Figure Germany Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)  
Figure France Ferroelectric RAM Consumption Growth 2013-2018 (M Units)  
Figure France Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)  
Figure UK Ferroelectric RAM Consumption Growth 2013-2018 (M Units)  
Figure UK Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)  
Figure Italy Ferroelectric RAM Consumption Growth 2013-2018 (M Units)  
Figure Italy Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)  
Figure Russia Ferroelectric RAM Consumption Growth 2013-2018 (M Units)  
Figure Russia Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)  
Figure Spain Ferroelectric RAM Consumption Growth 2013-2018 (M Units)  
Figure Spain Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)  
Table Middle East & Africa Ferroelectric RAM Consumption by Countries (2013-2018) (M Units)  
Table Middle East & Africa Ferroelectric RAM Consumption Market Share by Countries (2013-2018)  
Figure Middle East & Africa Ferroelectric RAM Consumption Market Share by Countries in 2017  
Table Middle East & Africa Ferroelectric RAM Value by Countries (2013-2018) (\$ Millions)  
Table Middle East & Africa Ferroelectric RAM Value Market Share by Countries (2013-2018)



Figure Middle East & Africa Ferroelectric RAM Value Market Share by Countries in 2017

Table Middle East & Africa Ferroelectric RAM Consumption by Type (2013-2018) (M Units)

Table Middle East & Africa Ferroelectric RAM Consumption Market Share by Type (2013-2018)

Figure Middle East & Africa Ferroelectric RAM Consumption Market Share by Type in 2017

Table Middle East & Africa Ferroelectric RAM Consumption by Application (2013-2018) (M Units)

Table Middle East & Africa Ferroelectric RAM Consumption Market Share by Application (2013-2018)

Figure Middle East & Africa Ferroelectric RAM Consumption Market Share by Application in 2017

Figure Egypt Ferroelectric RAM Consumption Growth 2013-2018 (M Units)

Figure Egypt Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)

Figure South Africa Ferroelectric RAM Consumption Growth 2013-2018 (M Units)

Figure South Africa Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)

Figure Israel Ferroelectric RAM Consumption Growth 2013-2018 (M Units)

Figure Israel Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)

Figure Turkey Ferroelectric RAM Consumption Growth 2013-2018 (M Units)

Figure Turkey Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)

Figure GCC Countries Ferroelectric RAM Consumption Growth 2013-2018 (M Units)

Figure GCC Countries Ferroelectric RAM Value Growth 2013-2018 (\$ Millions)

Table Ferroelectric RAM Distributors List

Table Ferroelectric RAM Customer List

Figure Global Ferroelectric RAM Consumption Growth Rate Forecast (2018-2023) (M Units)

Figure Global Ferroelectric RAM Value Growth Rate Forecast (2018-2023) (\$ Millions)

Table Global Ferroelectric RAM Consumption Forecast by Countries (2018-2023) (M Units)

Table Global Ferroelectric RAM Consumption Market Forecast by Regions

Table Global Ferroelectric RAM Value Forecast by Countries (2018-2023) (\$ Millions)

Table Global Ferroelectric RAM Value Market Share Forecast by Regions

Figure Americas Ferroelectric RAM Consumption 2018-2023 (M Units)

Figure Americas Ferroelectric RAM Value 2018-2023 (\$ Millions)

Figure APAC Ferroelectric RAM Consumption 2018-2023 (M Units)

Figure APAC Ferroelectric RAM Value 2018-2023 (\$ Millions)

Figure Europe Ferroelectric RAM Consumption 2018-2023 (M Units)

Figure Europe Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Middle East & Africa Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Middle East & Africa Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure United States Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure United States Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Canada Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Canada Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Mexico Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Mexico Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Brazil Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Brazil Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure China Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure China Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Japan Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Japan Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Korea Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Korea Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Southeast Asia Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Southeast Asia Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure India Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure India Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Australia Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Australia Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Germany Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Germany Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure France Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure France Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure UK Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure UK Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Italy Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Italy Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Russia Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Russia Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Spain Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Spain Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Egypt Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Egypt Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure South Africa Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure South Africa Ferroelectric RAM Value 2018-2023 (\$ Millions)

Figure Israel Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Israel Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure Turkey Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure Turkey Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Figure GCC Countries Ferroelectric RAM Consumption 2018-2023 (M Units)  
Figure GCC Countries Ferroelectric RAM Value 2018-2023 (\$ Millions)  
Table Global Ferroelectric RAM Consumption Forecast by Type (2018-2023) (M Units)  
Table Global Ferroelectric RAM Consumption Market Share Forecast by Type (2018-2023)  
Table Global Ferroelectric RAM Value Forecast by Type (2018-2023) (\$ Millions)  
Table Global Ferroelectric RAM Value Market Share Forecast by Type (2018-2023)  
Table Global Ferroelectric RAM Consumption Forecast by Application (2018-2023) (M Units)  
Table Global Ferroelectric RAM Consumption Market Share Forecast by Application (2018-2023)  
Table Global Ferroelectric RAM Value Forecast by Application (2018-2023) (\$ Millions)  
Table Global Ferroelectric RAM Value Market Share Forecast by Application (2018-2023)  
Table Cypress Semiconductor Basic Information, Manufacturing Base, Sales Area and Its Competitors  
Table Cypress Semiconductor Ferroelectric RAM Sales, Revenue, Price and Gross Margin (2016-2018)  
Figure Cypress Semiconductor Ferroelectric RAM Market Share (2016-2018)  
Table Fujitsu Basic Information, Manufacturing Base, Sales Area and Its Competitors  
Table Fujitsu Ferroelectric RAM Sales, Revenue, Price and Gross Margin (2016-2018)  
Figure Fujitsu Ferroelectric RAM Market Share (2016-2018)  
Table Texas Instruments Basic Information, Manufacturing Base, Sales Area and Its Competitors  
Table Texas Instruments Ferroelectric RAM Sales, Revenue, Price and Gross Margin (2016-2018)  
Figure Texas Instruments Ferroelectric RAM Market Share (2016-2018)  
Table IBM Basic Information, Manufacturing Base, Sales Area and Its Competitors  
Table IBM Ferroelectric RAM Sales, Revenue, Price and Gross Margin (2016-2018)  
Figure IBM Ferroelectric RAM Market Share (2016-2018)  
Table Infineon Basic Information, Manufacturing Base, Sales Area and Its Competitors  
Table Infineon Ferroelectric RAM Sales, Revenue, Price and Gross Margin (2016-2018)  
Figure Infineon Ferroelectric RAM Market Share (2016-2018)

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