ememory

力旺電子(3529)

A Leading Logic NVM Company

智慧財產權聲明

本文件內之資訊，包括文字、圖片、圖表、表格或其他檔案等，其所有權利或利益，包括但不限於所有權及智慧財產權，皆屬力旺電子所有，請尊重智慧財產權。本文件之內容包含力旺電子之機密資訊。部分內容可參見 2014 年出版之 Logic Non-Volatile Memory (The NVM solutions from eMemory)一書。任何在此之資訊在未經力旺電子書面同意，不得影印、散佈、複製、使用本文件或將其揭露予第三人。

eMemory, NeoBit, NeoFlash, NeoEE, NeoMTP 與 NeoFuse皆為力旺電子在台灣或其他國家之註冊商標或服務標章。

投資安全聲明

除簡報內所提供之歷史信息外，簡報事項係屬預測性陳述，受到風險及不確定性因素影響，可能造成實際結果與陳述內容發生不符，這些不確定性因素包括：技術平台是否順利導入利用、IP是否被客戶接受、客戶產品大量量產之能力及時間、產業及市場對半導體產品之供給及需求移轉、終端市場之穩定性及其他風險等。

大綱

- 公司營運模式
- 營運回顧
- 成長機會與未來展望
- 問題與回答

嵌入式非揮發性記憶體分類

SOC Block Diagram

Embedded Non Volatile Memory

Source : tsmc

嵌入式非揮發性記憶體技術

	ROM	eFuse (OTP)	Antifuse (OTP)	CMOS Floating Gate (OTP)	CMOS Floating Gate (MTP)	Embedded Flash
Cell Structure	Transistor	Poly Fuse	Antifuse	Floating Gate	Floating Gate	Floating Gate
Standard CMOS Compatible	Yes	Yes	Yes	Yes	Yes	No
Bitcell Area	< 1	50	1	2	4	1
Endurance	No	No	< 10	< 10	10K-100K	100-1000K
Density	4Kb-1Mb	256bit-4Kb	16bit-1Mb	16Kb-1Mb	1Kb-2M	64Kb-4Mb
Security	Low	Low	High	High	High	High
Additional Steps	None	None	None	None	None	+10 Mask

- ROM not programmable, eFuse cannot scale beyond 16Kb, embedded flash expensive and cannot scale after 40 nm
- eMemory's IPs: OTP (antifuse, floating gate) and MTP (floating gate)

採用IP之考量

Generally,
IP size is less than
10% of product size

Customers Request

1. **100% IP Reliability**
2. **No Mask Adder**
3. **Low Testing Cost**
4. **On call Service**
5. **Acceptable IP Size**

Nonvolatile Memory IP 內部

跨越鴻溝

營運模式

- 2000年成立，2002年第一個客戶，2005年開始獲利，2011年掛牌上市， 掛牌以來，無市場籌資，無銀行借款，現金配息率超過100%。
- 全世界最大的logic non volatile Memory IP公司，232位員工，162位研發人員*。
- 成長性指標: 1) 正在晶圓廠建構的製程平台數
  2) 設計授權數
  3) 權利金

前期授權金
=技術授權金 + 設計授權金

1-2 years
eMemory & foundry development

Technology License Revenue

1-2 years
Fabless product development

Design License Revenue

3+ years
Multiple application & sales

Royalty Revenue Continues

權利金
=客戶於晶圓量產時向晶圓廠收取

Note*: 截至 2016/12/31

全球客戶

	Taiwan	China	Korea	Japan	North America	Europe	Others
Foundry	5	7	3	3	1	2	1
IDM	0	0	0	8	2	1	0
Fabless	264	496	66	51	226	111	50

Foundry

IDM

專利佈局

	Q3 16	Q4 16	Diff.
Pending	204	218	+ 14
Issued	371	389	+ 18
Total	575	607	+ 32

Note*:截至 2016/12/31

每季營收模式

- 每季第一個月認列絕大部份晶圓廠前一季使用本公司IP的出貨晶圓權利金及當月產生的技術授權金及設計授權金；第二個月則是少部份晶圓廠權利金及當月授權金；第三個月則無權利金收入，只有授權金。

單位：台幣仟元

大綱

- 公司營運模式
- 營運回顧
- 成長機會與未來展望
- 問題與回答

第四季各項營收

單位：新台幣仟元

	Q4 2016	Q3 2016	QoQ	Q4 2015	YoY	2016	2015	YoY
Licensing	79,684	86,712	-8.10%	69,307	14.97%	330,087	267,512	23.39%
Royalty	226,543	222,655	1.75%	231,571	-2.17%	885,372	824,108	7.43%
Total	306,227	309,367	-1.01%	300,878	1.78%	1,215,459	1,091,620	11.34%

單位：合約數

		Q4 2016	Q3 2016	2016	2015
Technology Licenses		10	6	43	28
Design Licenses	NRE	12	18	56	57
	Usage	73	81	311	349

綜合損益表

(單位:新台幣仟元)	Q4 2016	Q4 2015	% change	2016	2015	% change
營業收入淨額	306,227	300,878	1.8%	1,215,459	1,091,620	11.3%
營業毛利率	100%	100%	-	100%	100%	-
營業費用	171,681	156,216	9.9%	685,650	570,403	20.2%
營業淨利率	43.9%	48.1%	-4.2ppts	43.6%	47.7%	-4.1ppts
本期淨利	132,361	128,090	3.3%	534,917	479,111	11.6%
純益率	43.2%	42.6%	+0.6ppts	44.0%	43.9%	+0.1ppts
每股盈餘 (單位: 新台幣元)	1.75	1.69	3.6%	7.06	6.32	11.7%
權益報酬率	28.3%	28.4%	-0.1ppts	28.6%	26.6%	+2.0ppts

技術授權合約

單位：合約數

Year	2013	2014	2015	2016
License number	19	21	28	43

註: 與晶圓廠簽訂的技術授權合約所含的技術製程及授權金視合約內容而定，無特別季節性因素。

目前正在建構的技術製程平台

- Total (As of Dec.) : 104
- 19 for NeoBit, 43 for NeoFuse, 22 for NeoEE, and 20 for NeoMTP.

	7/10nm	14/16nm	28nm	40nm	55/65nm	80/90nm	0.11~ 0.13um	0.15~ 0.18um	>0.25 um
NeoBit	-	-	-	-	-	-	6	13	
NeoFuse	2	3	8	6	10	5	6	3	-
NeoFlash	-	-	-	-	-	-	-	-	-
NeoEE	-	-	-	-	-	-	5	17	-
NeoMTP	-	-	-	-	1	2	5	12	-

目前正在建構的技術製程平台

12" Fabs	Production	Development	NVM Type	Process Type
7/10nm	0	2	OTP	FF
14/16nm	1	3	OTP	FF+
28nm	6	8	OTP	LP/HPM, HLP/HPM, LPS
40nm	4	6	OTP, MTP	HV-DDI, LP
55/65nm	14	11	OTP, MTP, Flash	LP, HV-DDI, HV-OLED, DRAM, CIS
80/90nm	6	7	OTP, MTP	HV-DDI, HV-OLED, LP
0.13/0.11um	8	2	OTP, Flash	HV-DDI, BCD, Generic
0.18um	1	0	OTP	BCD

8" Fabs	Development	NVM Type	Process Type
0.13/0.11um	20	OTP, MTP, Flash	HV-DDI, BCD, LP, RF, CIS, LL
0.18/0.16/0.152um	45	OTP, MTP	Generic, LP, LL, MR, HV, Green, BCD
0.25um	0	OTP, MTP	BCD
0.35um	0	OTP	UHV

Note*:截至 2016/12/31

每季設計授權數(New Tape Out)

- Total 367 NTO as of 2016(406@2015,445@2014, 393@2013, 303@2012)

	2012 Q1	2012 Q2	2012 Q3	2012 Q4	2013 Q1	2013 Q2	2013 Q3	2013 Q4	2014 Q1	2014 Q2	2014 Q3	2014 Q4	2015 Q1	2015 Q2	2015 Q3	2015 Q4	2016 Q1	2016 Q2	2016 Q3	2016 Q4
NRE	7	15	10	10	7	14	18	12	33	12	22	15	21	17	10	9	12	14	18	12
Usage	62	68	63	68	73	69	88	112	90	86	88	99	82	87	76	104	63	94	81	73

Note*: 客戶在各代工廠的諸多MCU NTO已陸續進入量產，加上與主要Green process代工廠的商業模式商業模式調整為直接license IP cell 給代工廠, 由代工廠提供設計服務給客戶，造成tape out 數減少，但仍對使用IP cell 的晶片支付權利金. 雖然MCU的NTO數量有明顯減少，但是相關的晶圓產出和權利金收入還是持續增加。

權利金取決於過去累積的設計授權數

註1. 2009年因整體半導體景氣衰退，權利金年衰退1.5%。
註2. 2011年因2010年單一客戶預付權利金，導致2010年成長67%，2011年年衰退6.3%。
註3. 2009-2013年權利金年複合成長率為30%。

每季量產晶圓片數

embedded eMemory IP in T Company ($revenue); * % of Process node in T company total revenue in Q4 2016

	Process node	*% of T	Q4 16	Q3 16	2016	2015
8”	0.25/0.35	2%	26.80%	26.44%	28.15%	33.49%
	0.15/0.18	10%	10.93%	13.07%	12.43%	8.73%
	0.11/0.13	2%	58.06%	40.96%	42.61%	29%
12”	90nm	5%	14.8%	3.83%	12.50%	19.85%
	65nm	11%	3.9%	3.85%	3.59%	0.55%
	40/45nm	12%	0	0	0.00%	0%
	28nm	24%	0.70%	0.61%	0.55%	0.05%
	16/20nm	33%	0%	0	0.00%	0%
8”		15%	18.60%	20.1%	18.86%	16.64%
12”		85%	1.56%	0.87%	1.44%	1.87%
Total		100%	4.12%	3.95%	4.27%	4.76%

大綱

- 公司營運模式
- 營運回顧
- 成長機會與未來展望
- 問題與回答

力旺之NVM技術

- **Logic NVM portfolio offers one-stop-shop solution.**
  - Compatible to any process
  - Robust structure
  - Low process cost
  - Competitive macro sizes
  - Easy integration
  - Easy porting

eMemory's NVM Technology	OTP		MTP		
	NeoBit	NeoFuse	NeoFlash	NeoEE	NeoMTP
Product Type	OTP	OTP	Flash	EEPROM	MTP
Endurance (Cycles)	10	10	1K~10K	10K~100K	1K~10K
Additional Mask Steps	0	0	2-3	0	0
Technology	Floating gate	Anti-Fuse	SONOS	Floating gate	Floating gate
Scalability	Simple	Simple	Simple	Simple	Simple
Memory Density	HD < 512Kb GHD < 16Mb	< 4Mb	< 2Mb	< 4Kb	< 512Kb

力旺IP的應用

12"							8"			
7nm	10nm	16nm	28nm	40nm	55/65nm	80/90nm	110/130nm	160/180nm	250nm	350nm

商機與潛力

Note: 2.2 million 8” equivalent wafers with eMemory IP were shipped in 2013. (~5% of WW foundry shipment)

智慧型手機中力旺 IP 的應用

Source: eMemory Marketing

Benefits from Using eMemory IPs

Design-in for
1. Trimming
2. Parameter Setting
3. Code Storage
4. Identification Setting
5. Encryption
6. Function Selection

Package/FT level
1. Trim : SPEC shift
2. Parameter Setting : cross chip optimization
3. Identification Setting : manufacturer resume
4. Function Selection : setting for target market

CP level
1. Trim : output voltage or current
2. Parameter Setting : default value
3. Code Storage : default F/W code

System Assembling
1. Parameter Setting : cross chip optimization
2. Code Storage : F/W code modification
3. Identification Setting : manufacturer resume
4. Encryption : Security algorithm or key storage

高機密性的安全設定

- Provide “Invisible Hardware Key” for invisible storage
- Prevent reverse-engineering to detect content of security key
- Protect firmware and hardware of ICs from pirating
- Extend & protect customer’s business

eFuse Key: Data is easily observed

Invisible Hardware Key : Data is hard to be detected

Floating Gate

Anti-Fuse

硬體設計防護

Authorized Product

Fake Product

reverse copy

re-produce

without protection

reverse copy

re-produce

with protection

Security IP/Code by Authorized Use

Can NOT Work w/o Security IP/Code

OTP在加密儲存應用

Source： Rambus crypto manager platform

力旺矽智財引領高安全性應用

在IoT中之NVM IP 需求

Autotronics with eMemory IPs

Intelligent drive Distronic system

Neo Bit | Neo Fuse

Infotainment system

Neo Bit | Neo Fuse

Sensor system

Neo Bit | Neo EE

Auto parking system

Neo Bit | Neo Fuse

Blind Spot Warning System Cockpit System

Neo Bit | Neo Fuse

OBU & GPS

Neo Bit | Neo Fuse

Keyless door

Neo Bit | Neo EE

Rear view system

Neo Bit | Neo Fuse

Imager Module with eMemory IPs

先進液晶顯示驅動晶片

Process Technology : 0.11um HV/80nm HV/55nm HV

I/F
(LVDS, MIPI,…)

DDI

Density	Endurance	NVM Type	Purpose	NVM Usage
2K8~4K8	1	OTP	Trimming	1. Accuracy enhancement 2. Mismatch cancellation
			Code Storage	1. Gamma Correction Table 2. Timing Control Pattern 3. Color Engine Enhancement

應用於Baseband與Application Processor的電源管理晶片

Process Technology : Advanced 0.25um BCD/ 0.18um BCD/ 0.13um BCD
Mature 0.18um/0.16um/0.152um Logic

Density	NVM Type	Purpose	NVM Usage
2Kb~4Kb	OTP	Trimming	DC/DC, Bandgap
		Parameter Setting	Design flexibility & Performance optimization
		Code Storage	Start-up behavior & smart power saving algorithm

PMIC Neo Bit

觸控面板控制器晶片

Process Technology : 0.16um HV/0.11um G

Density	Endurance	NVM Type	Purpose	NVM Usage
16K8~32K8	<1000	MTP	Code Storage	F/W code
			Parameter setting	Customized model and performance optimization

內嵌式觸控面板控制器晶片

Process Technology : 0.11um HV/80nm HV/55nm HV

Density	Endurance	NVM Type	Purpose	NVM Usage
2K8~4K8	1	OTP	Trimming	Accuracy
			Code Storage	Gamma Table
16K8~32K8	<1000	MTP	Code Storage	Touch F/W Code
			Parameter setting	Performance Optimization

CMOS 影像感測器

Process Technology : 0.11um CIS/90nm CIS/65nm CIS

Density	Endurance	NVM Type	Purpose	NVM Usage
2Kb~4Kb	1	OTP	Identification Setting	Product Code
			Parameter Setting	Start-up Initial Setting
32K8	1	OTP/ROM	Code Storage	Boot Load

微機電系統(MEMS)

180/160/15x nm HV/Logic for MEMS Controller

Density	NVM Type	Purpose	NVM Usage
2Kb~4Kb	OTP	Trimming	Factory trimming
		Parameter Setting	Signal filtering
		Code Storage	Geometric computation

取代嵌入式快閃記憶體之競爭優勢

product design & manufacturing by embedded Flash Logic Process + 10 Masks

30% more cost reduction

(wafer cost & testing time)

product design & manufacturing by Embedded Logic NVM (OTP/MTP) Logic Process

EEPROM應用於MCU

external
EEPROM

One-time
storage for
ID, trimming,
encryption…

EEPROM for
user data, parameter
setting, system
function…

NeoBit + NeoEE

Hybrid NVM solution (NeoBit + NeoEE) with customized SPEC & optimized size

- **One single IP by integration of NeoBit & NeoEE**
- **Help for system size reduction**

IC種類之晶圓需求

IC Type	Equa to 8-inch wafer (K)
AP	4926
PMU	4508
Smart card controller	3667
Base Band controller	2429
CIS sensor	1975
LCD driver (int with TCON)	1892
Fingerprint	744
Gauge IC	670
Touch panel controller (C)	581
TV controller	579
Connectivity (Combo)	437
STB controller	330
Wifi controller	293
DC-DC/AC-DC	190
LED driver	141
BT controller	132
Light sensor	123
Accelerator sensor controller	114
TAG IC	100
ISP	98
Gyroscope sensor controller	90
MCU (8bits, pure 5V)	65
P-Gamma	40
MCU (8bits, LV/3.3V)	39
NB CAM controller	36
Pressure sensor controller	21
PC CAM controller	8
TCON (w/o driver)	3

2016 Q3 updated

未來展望

- 授權金：
  - 在各大代工廠持續進行先進製程及MTP的平台開發，及累計IP library數的增加，將帶動計術授權金及設計授權金的成長。
- 權利金：
  - 8吋晶圓：主要來自於多個fingerprint sensor 客戶開始進入量產，佔權利金比例已經開始顯著增加，預期會有更多客戶導入量產。Fast charger 及wireless charger 導入手機比例增加及美國最大PMIC客戶新產品線的量產，將會帶動電源管理相關應用的成長。
  - 12吋晶圓：TDDI、OLED、STB/DTV、CIS及Security等相關應用的已經開始量產，將會帶動12吋權利金成長。

未來展望

- 技術研發：
  - 16奈米已有客戶tape-out，10奈米的第一個IP已驗證成功，7奈米的測試晶片計畫2月份tape-out，車用電子已有多個客戶tape-out, 將可為未來幾年權利金的成長帶來動能。

成長驅動力

Growth in application per mobile devices	• More chip applications per smartphone/tablet product.
Growth into more markets	• From consumer electronics and mobile devices to wearable devices. • Adding new NVM product lines further enable more product applications.
Growth in advanced technology	• Higher royalty per wafer is contributed from more advanced technology nodes.
Great IoT era	• Embedded Logic NVM will be a must.

Q & A

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Embedded Wisely, Embedded Widely