Constrained sintering process for LTCC Fodel® Process

Dr. Shukin Ryo
(듀폰-저팬)

Fodel Process & Constrained Sintering for LTCC

S.Ryo
Account Supervisor
Microcircuit Materials.

DuPont *i Technologies*

Sep 2nd ,2000
IMAPS KOREA

Market Status *(LTCC / Fodel Related)* in Japan

♦ **Booming in use of Hi-Density Multilayer Boards in IC Pkg. /CPU/Consumer Area**
  - *Build-Up PWB / ALIVH are leading technology.*

♦ **Increasing requirements for Finer pitch** (*< 85μm pitch*) **and/or Flip chip assembling on to board.**

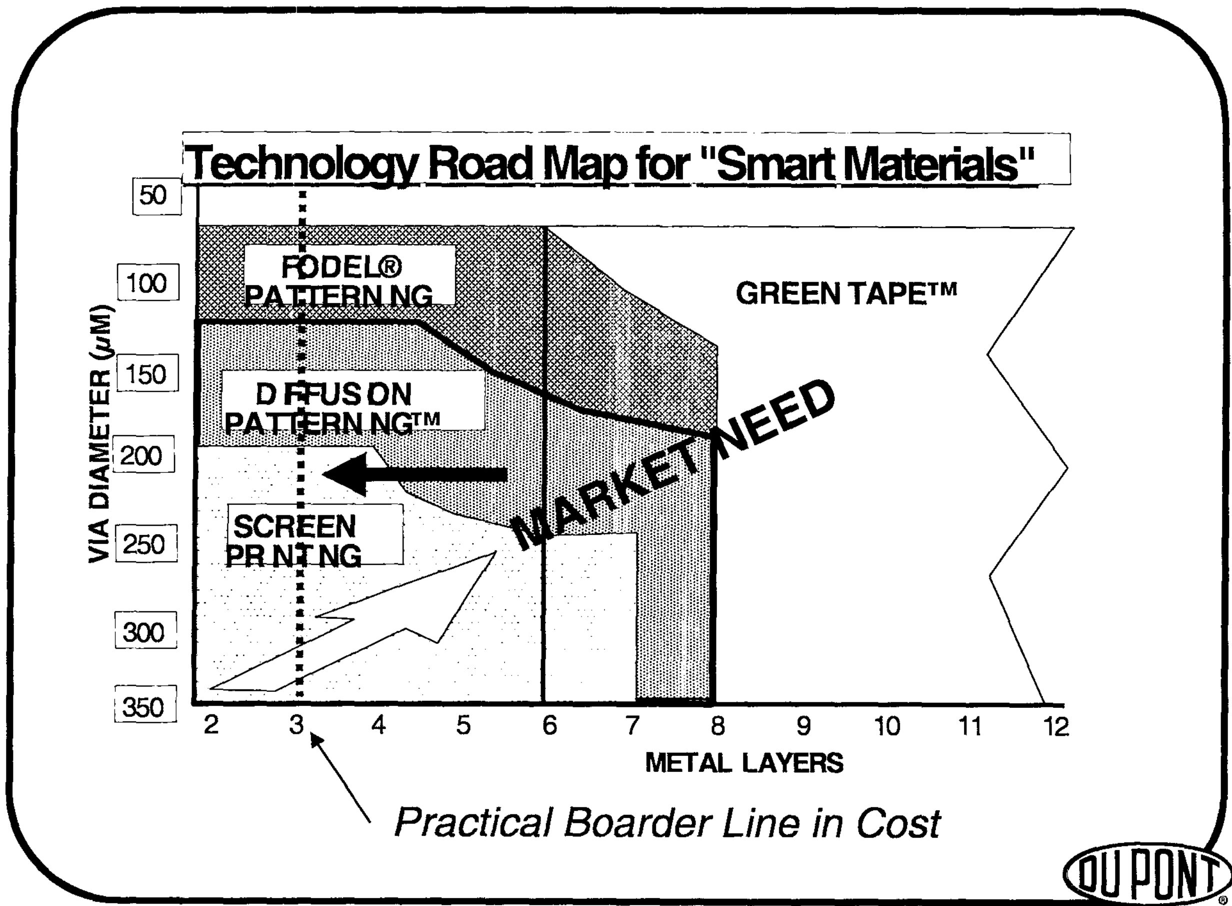
♦ **BGA connection become more popular and BGA connection cracking become industry's issue.**

♦ **Emerging MCM's on Build-Up PWB in Consumer Area**
  - *Pentium II / Note PC CPU / Casio Radio / TV Phone Camera*

♦ **LTCC in Automotive application become real finally both in Japan and Europe. European Automotive will deeply link with Japanese LTCC makers/Module makers.**

♦ **Be unaware of LTCC technology in the industry especially circuit designers**
  - *Recognized HTCC only as ceramic technology and Alumina is recognized for traditional hybrid only.*

♦ **『Fodel® on constrain sintered LTCC with buried R』technology can compete with Build-Up PWB.**
  - *< 85μm pitch top patterning // < 100μm via ϕ // < 10μm/10mm coplanarity // Buried R*

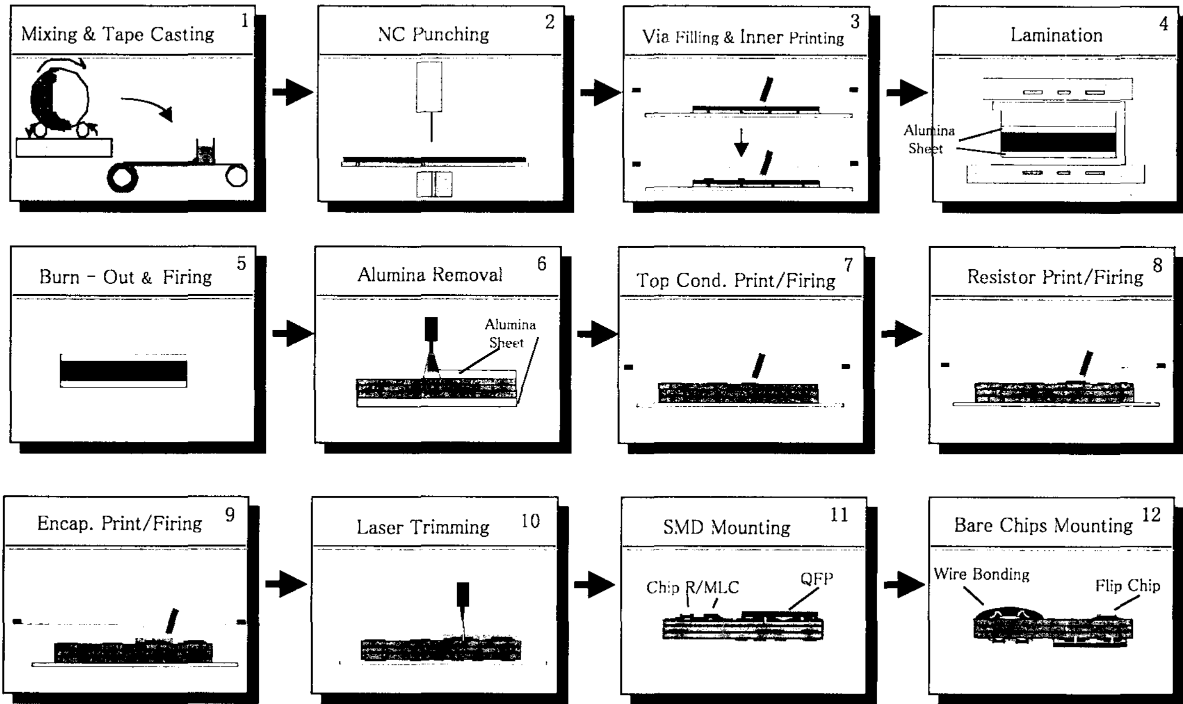


LTCC Process Comparision

	Free Sintering		Constrain Sintering(Zero XY Shrinkage)	
	Post-Fire Fire top conductor after fired LTCC substrate	Co-Fire *Co-fire top conductor with* LTCC substrate	PLAS Pressure less Assisted Sintering Fire without Pressure	PAS Pressure Assisted Sintering Fire with Pressure
Process characteristic	Standerd Firing for LTCC	Minimize misalignment of top conductors/via pads on via locations since co-firing between top and LTCC. Best for LTCC with cavity structure	Fire LTCC parts sandwitced with green alumina tapes after lamination.	Fire LTCC parts with pressute in addition to PLAS process. Expensive for *special firing equipment.*
PAT Situation on Process	—	—	Du Pont hold PAT in US・Europe/Japan and license several customers	Du Pont hold PAT in US・Europe/Japan and license several customers
Fired LTCC characteristic			・Can make Hi-density LTCC ・Can make thin and flat *LTCC*	・Can make Hi-density LTCC ・Can make thin and flat LTCC
Fired LTCC *feature*			Increase # of parts from one substarte and higher yield with less misalignment due to zero XY-shrinkage give lower cost. No influence from lot variation in tape shrinkage.	Increase # of parts from one substarte and higher yield with less misalignment due to zero XY-shrinkage give lower cost. No influence from lot variation in tape shrinkage.
XY shrinkage(Green->Fired)	13～16%±0.5%	13～16%±0.5%	0.1%± 0.05 %	0.1%± 0.05 %
Z shrinkage(Green->Fired)	20～30%±0.5%	20～30%±0.5%	45～50%±0.5%	45～50%±0.5%
Flatness - Coplanarity	10～50μm／10mm	10～30μm／10mm	<10μm／10mm	10～20μm／10mm
Tape	Wide selection	Wide selection	Difficult to use Pb-free tape *so far*	Wide selection
Via/Inner Electrodes	Wide selection	Wide selection	Very difficult in matching shrinkage with hi-Ag to tape	Difficult in matching shrinkage with hi-Ag to tape, but not as well as PLAS
Top Conductors	Need chemical *compatibility with tapes*	In addition to chemical matching, matching in shrinkage or bowling is needed physically	Need chemical compatibility with tapes	Need chemical compatibility with tapes

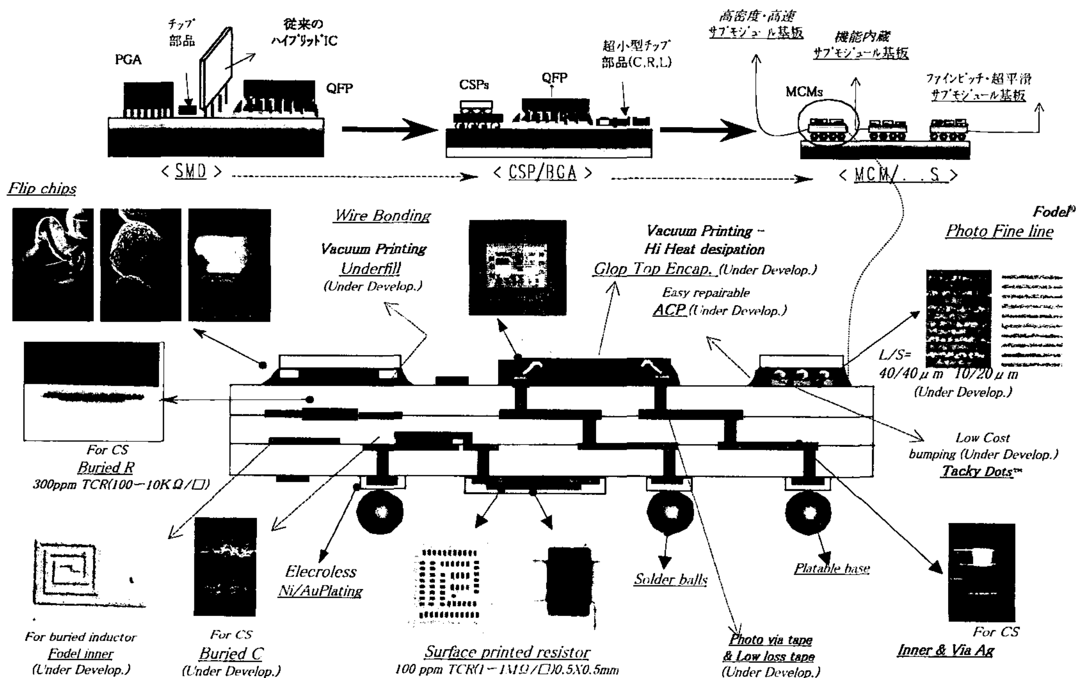
DUPONT

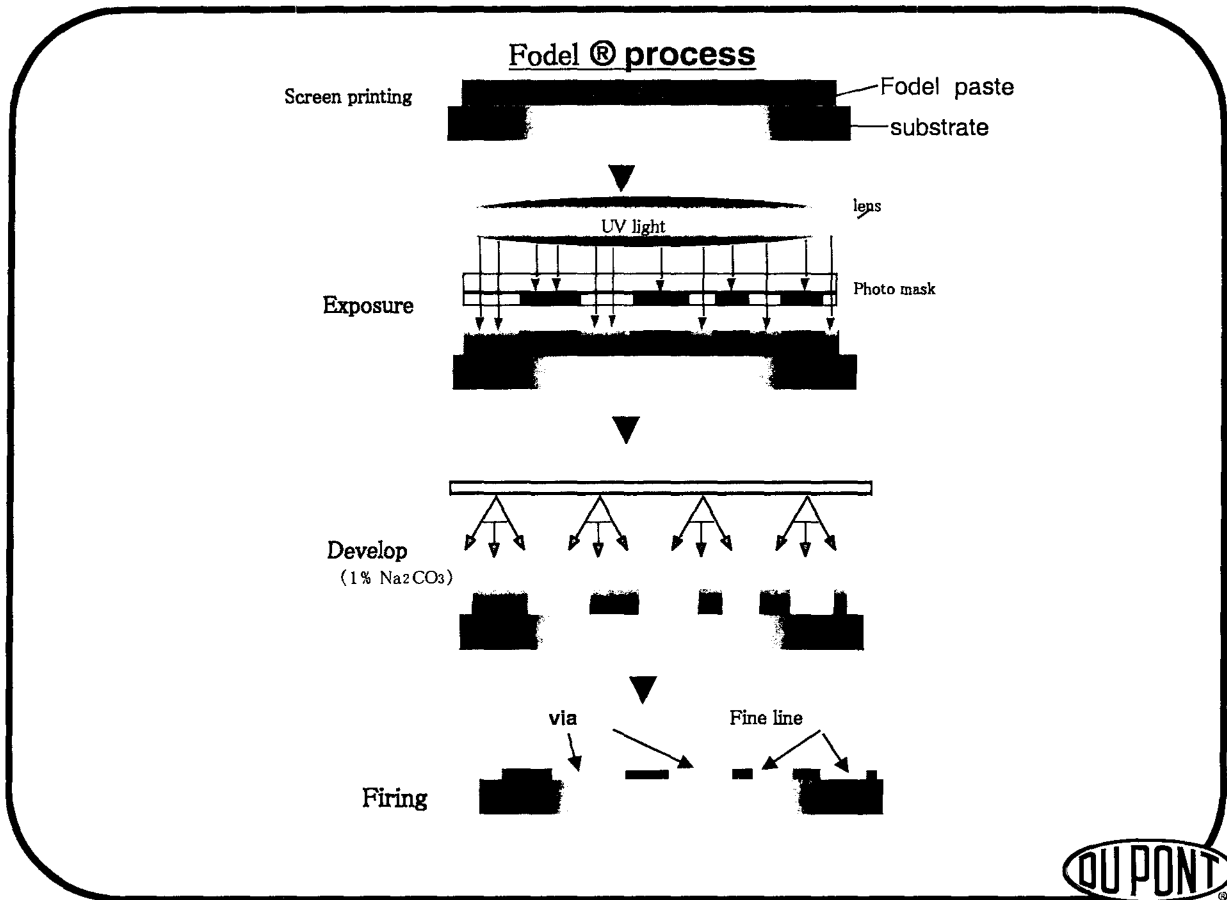
Constrain Sintering LTCC Mfg. Process



Picture provided from MKE

LTCC Portfolio #2





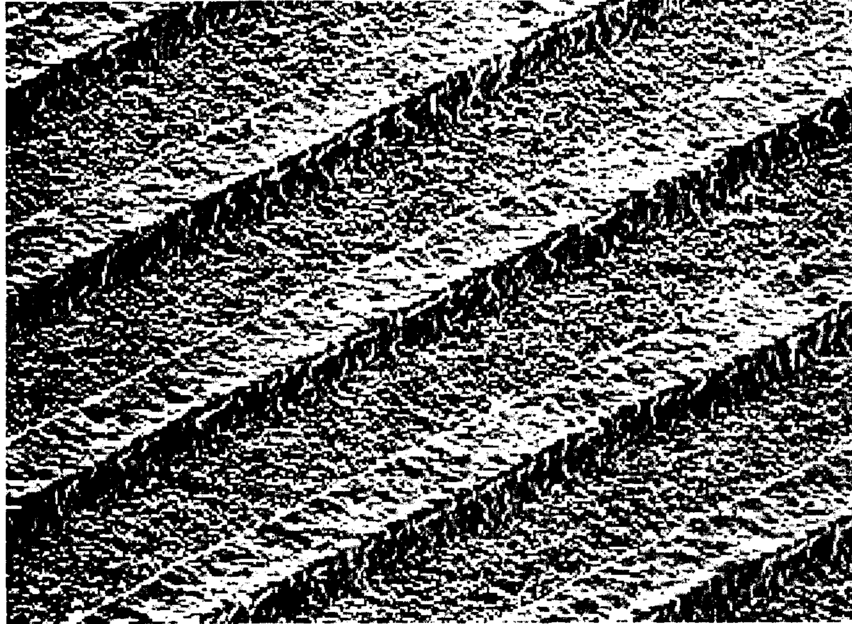
Fodel® Standard Process

Pt/Ag Platable Conductor

Process	Recommendation	Remarks
Dry thickness	12 ~ 18μm	Screen printing
Leveling	10min	@ Room temperature
Drying	80℃ / 20min	Dry oven
Exposure	600 ~ 1,000mj / cm^2	Hg or Hg/Xe UV Light(λ_{max} : 635nm)
Develop	TTC* X 1.2 ~ 2.0	0.4% Na_2CO_3(Sodium carbonate)30℃
Fring	850℃ / 10min(Peak)	Belt furnace

*) TTC: Total Time to Clean

Fodel®Ag/Pt 7090



On Alumina

30 μ m / 30 μ m (Line & Space)

Line Resolution

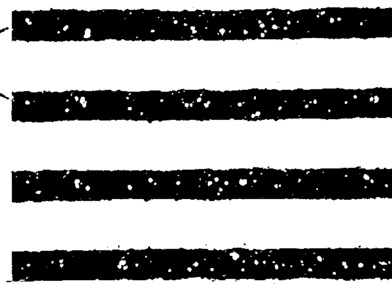
Fodel® vs Screen Printing

	Screen Printing	Fodel®
	6002F Low Temp. Cu	Fodel® Platable Pt/Ag

Top View
Back Light

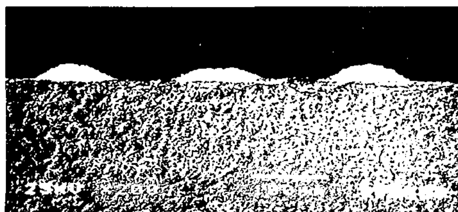
50 μ m W

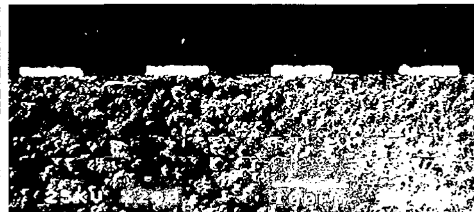
Lines



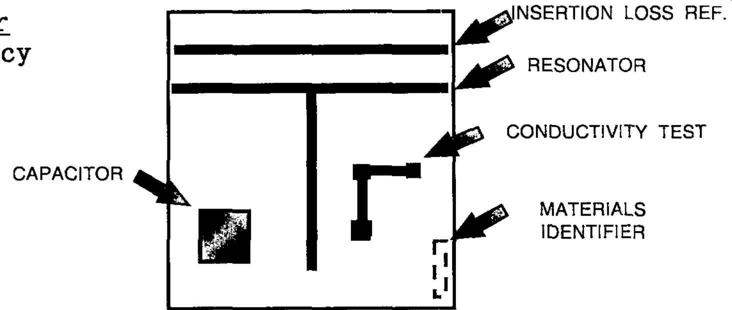
X-Section

75 μ m W

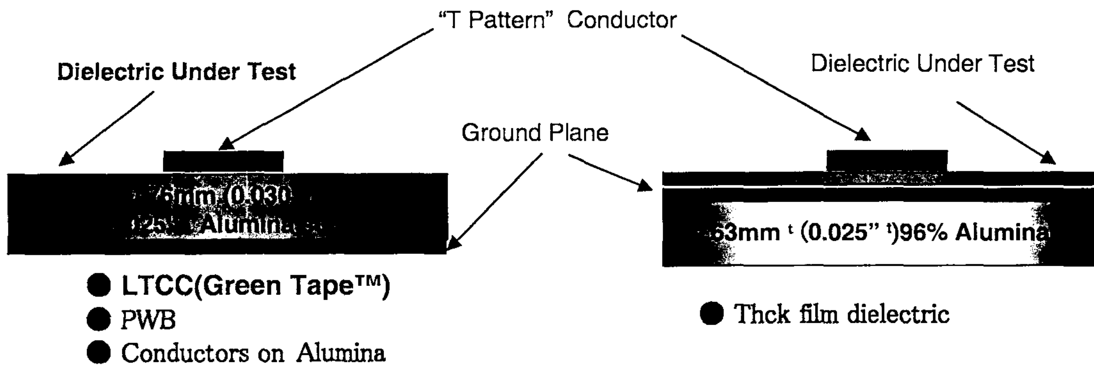




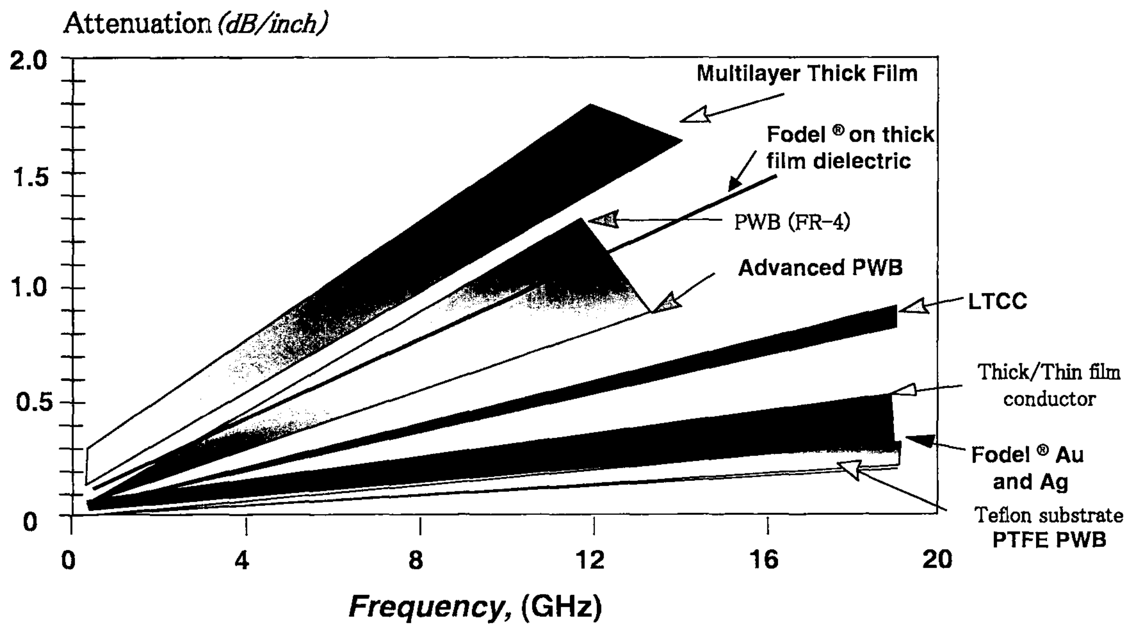
T Patternt Resonator
for high frequency
characterization



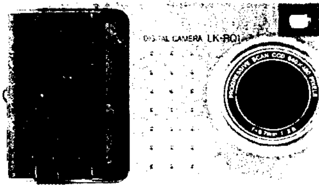
T Pattern Test Sample Construction



Comparison of high frequency performance
Attenuation–Frequency 50 Ω microstrip line

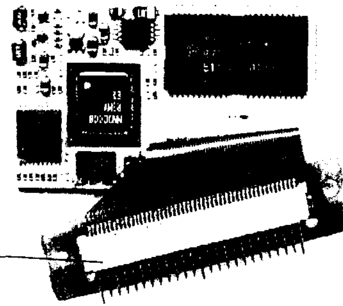


M K E D S C 2 n d M o d
M a d e u s i n gx L T



Bottom View

CSP on HTCC Interposer



Brad Pitt
Marketing Manager
Microcircuit Materials, Asia Pacific

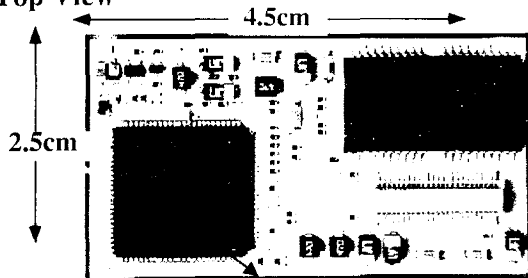
DuPont K.K.

松下寿電子工業㈱社製カードサイズ・(9.1X6.0cm)デジタルスチールカメラに採用されている10枚11層の無収縮LTCC基板(2.5X4.5cm)が心臓部であるディジタル回路に使われている。両面部品実装でフレキシブル・ケーブル・コネクターを異方性接着材で接合した世界初のセラミック・リジッド・フレックス基板のハイブリッド・モジュールである。またQFP↑下には1005より小さいサイズの抵抗が70個、最上層に印刷されている。

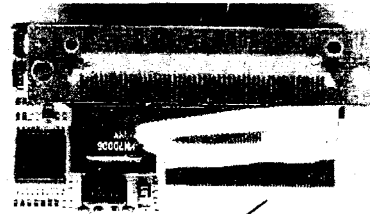
Top View

4.5cm

2.5cm

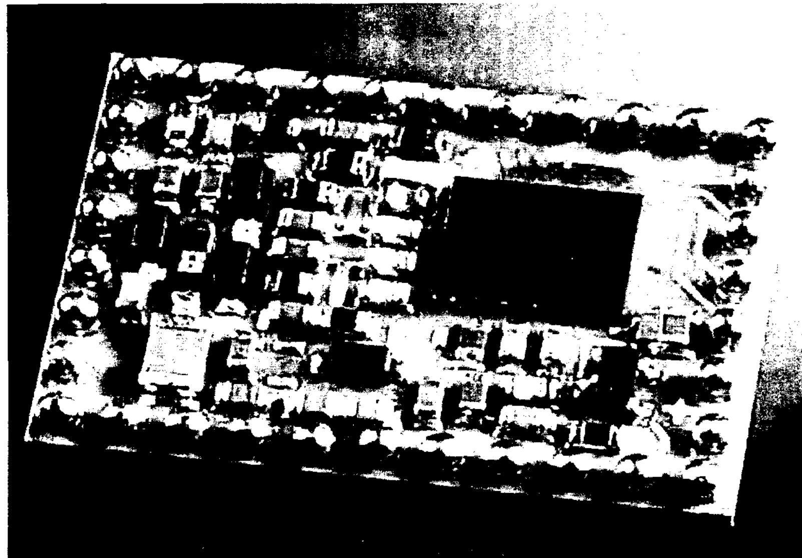


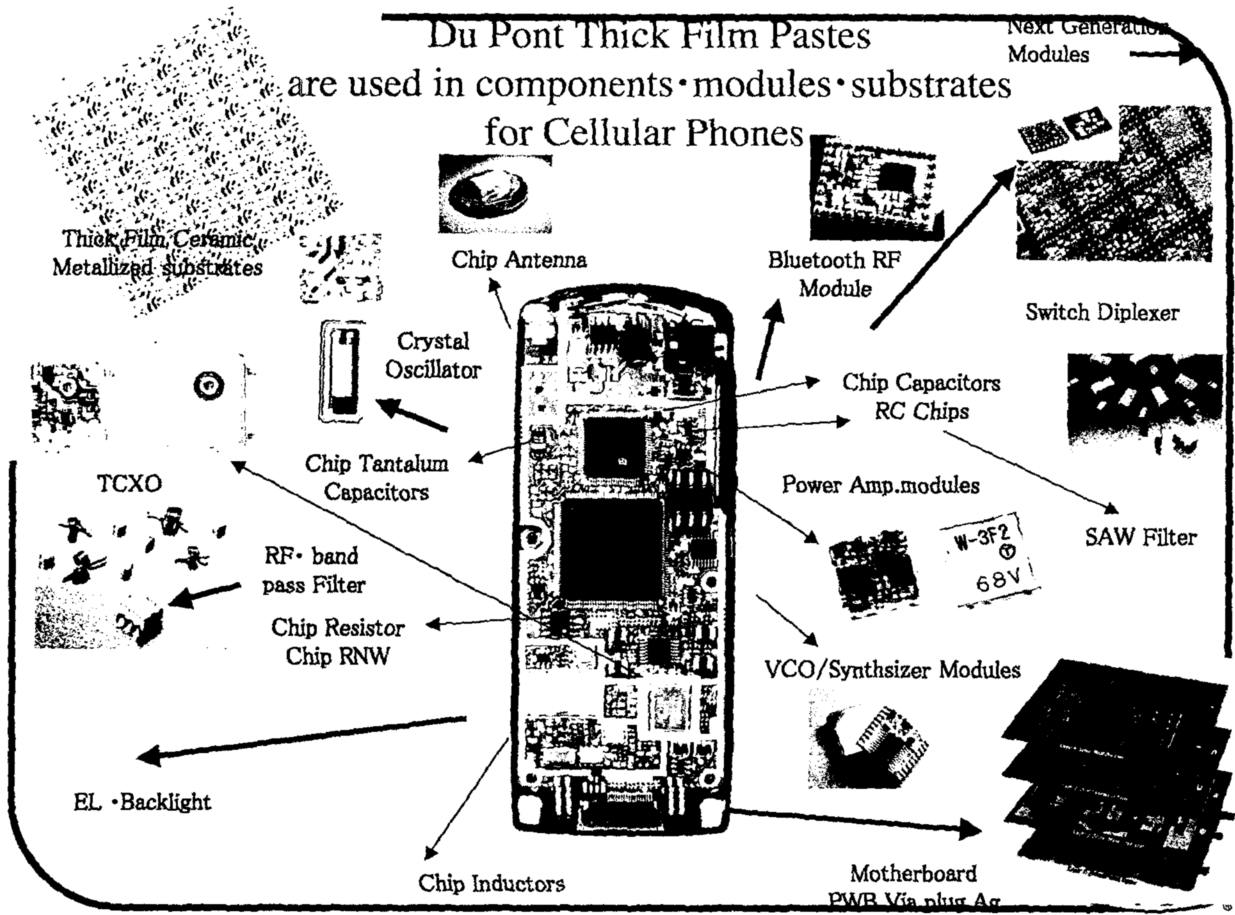
70 Printed Resistors (0.5 mm X 0.5 mm)
Underneath QFP



C o n n e cF

BLUETOOTH MODULE




Du Pont Thick Film Pastes
are used in components・modules・substrates
for Cellular Phones
Next Generation
Modules
Thick Film Ceramic
Metallized substrates
Chip Antenna
Bluetooth RF
Module
Switch Diplexer
Crystal
Oscillator
Chip Capacitors
RC Chips
TCXO
Chip Tantalum
Capacitors
Power Amp.modules
SAW Filter
RF・band
pass Filter
Chip Resistor
Chip RNW
VCO/Synthsizer Modules
EL ・Backlight
Chip Inductors
Motherboard