

Parametric Cost Estimating: A Practical Independent Method of Estimating the Manufacturing Cost of Chips to Modules in the Peoples Republic of China

Ralph W. Farrington
RWF Consulting LLC
P.O. Box 2924
Newport Beach, California, 92659-0408 USA
and Kaifeng, Henan, China
Email: fangrf@rwfconsulting.com

Why use the parametric cost estimating method?



- We know the Shenzhou 5 program cost 2 billion U.S dollars to build. (Tu Yun, CRI news)
- We know that we need a better estimating method for future systems and components. The accounting systems can report only past incurred costs and the historical costs often do not lend themselves to future estimates.

So what are the alternatives that we can use for cost estimating?

1. Use prior system costs and extrapolate (analogy method). This is the least accurate approach.
2. Attempt to determine the detailed cost elements of a system or component that may not be designed (bottoms-up cost estimate). This method is time consuming and costly.
3. Use a parametric cost estimating system to incorporate the best of alternatives 1 and 2.

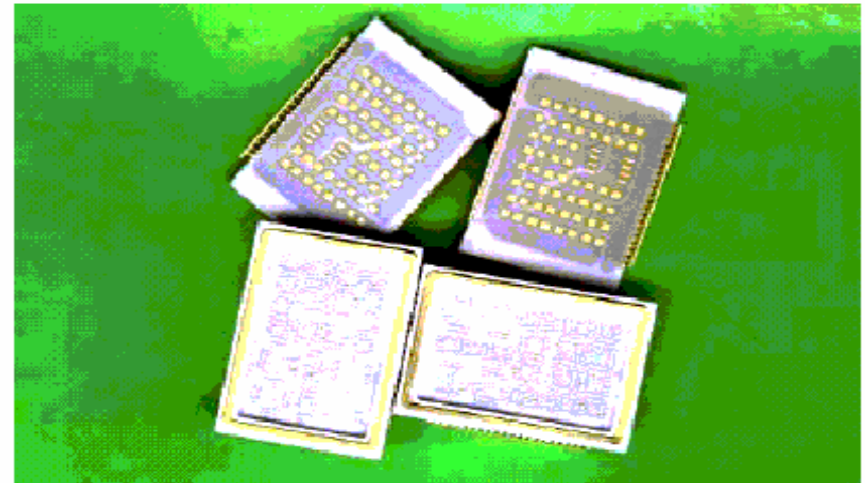
Parametric Estimating:

- The PRICE System Suite of parametric estimating systems is based upon your available engineering knowledge and your known rates and factors and proven detailed actual industry estimating relationships. PRICE M is the model used for microcircuits and modules.

The PRICE (M) Electronic Module

Estimating Parametric Model can help us estimate circuits from chips to modules

- The PRICE M model is used to estimate costs, resources (labor and material) and schedules for development and production of custom microcircuit chips and /or electronic modules.
- For example, it could estimate PRC chips (Shanghai) or PRC microcircuits (Shijiazhuang):



We will demonstrate the use of PRICE M to do an independent cost estimate of a recently developed commercial microcircuit (as if estimated in PR China).

Estimating a LTCC Microcircuit module:

The microcircuit we will use in this demonstration is a RADAR Sensor for Automotive Applications in LTCC using technical data obtained from the IMAPS publication *Advancing Microelectronics* (March/April 2005 issue) and specific IMST information used with permission by IMST GmbH (Germany).

IMST: RADAR Sensor for Automotive Applications in LTCC



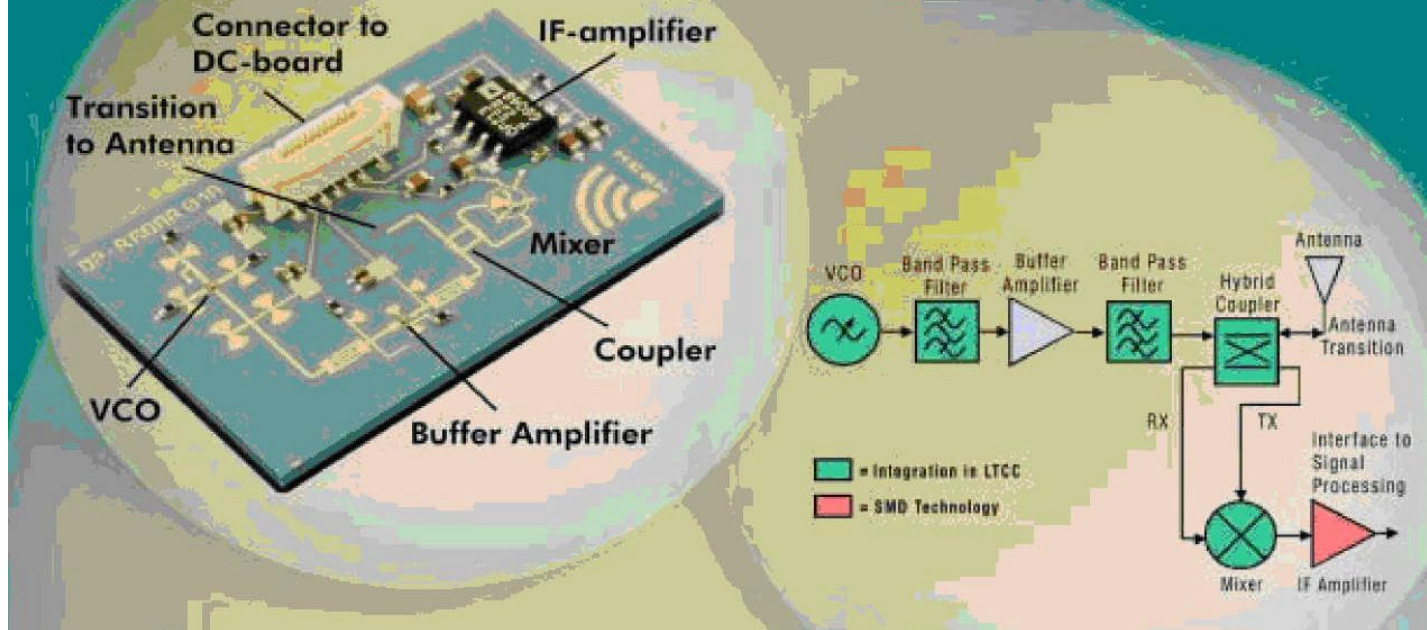
Advancing Microelectronics



Everything in electronics between the chip and the system!

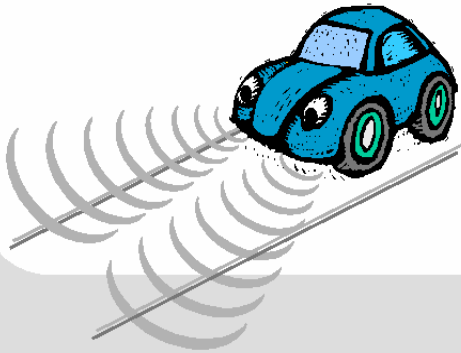
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24 GHz RADAR Module

RADAR Sensor for Automotive Applications in LTCC



A Joint Project of
IMST GmbH and
DuPont Microcircuit Materials

© IMST GmbH, BK, LTCC RADAR
Sensor, July 2004



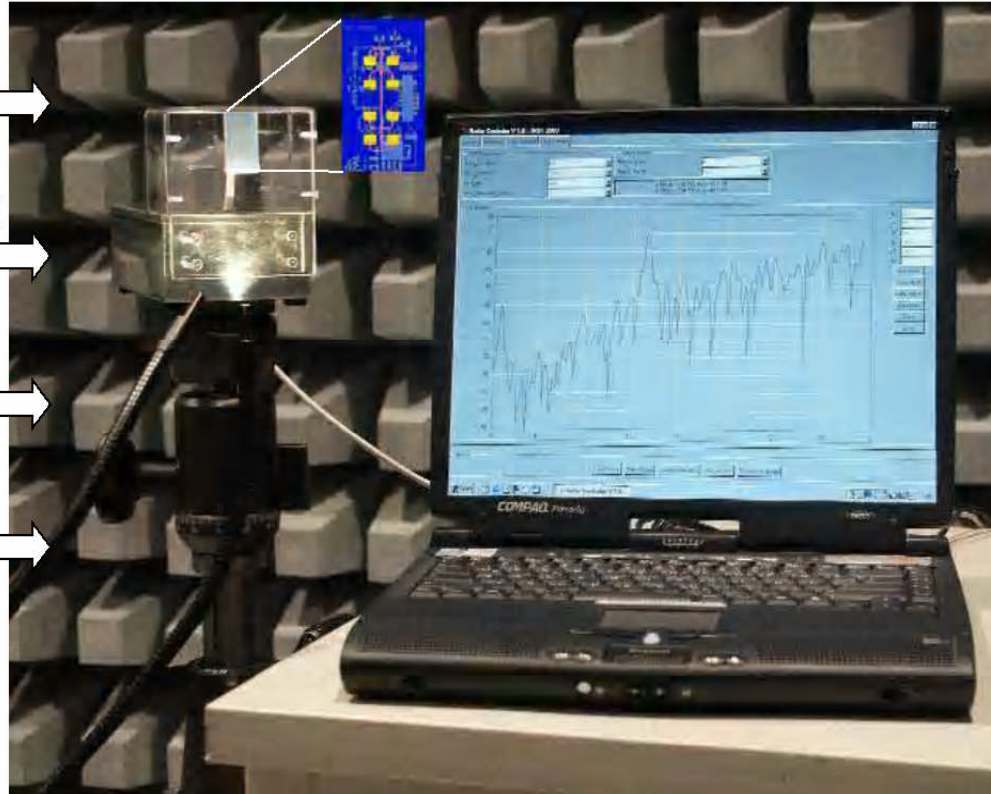
Demonstration Module with Software

FMCW
RADAR Sensor

Signal Processing
Unit

USB Interface

GUI and
Evaluation
Software



© IMST GmbH, BK, LTCC RADAR
Sensor, July 2004

FMCW
USB
GUI

Frequency Modulated Continuous Wave
Universal Serial Bus
Graphical User Interface



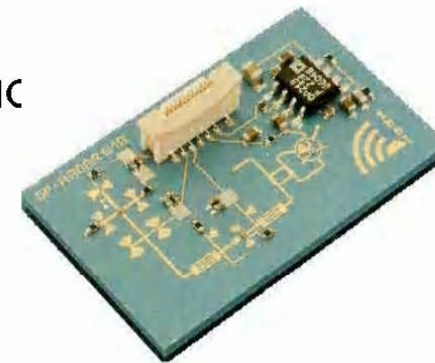
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Goal Specifications

- **RADAR-Method** FMCW
(Frequency Modulated Continues Wave)
- **Distance to Obstacles** 10 cm ... 30 m
- **Obstacle Separation** ± 10 cm
- **Resolution** ± 1 cm
- **Centre Frequency** 24 GHz ($f_{ISM} = 24.125$ GHz)
- **Band Width** 2 GHz ($b_{ISM} = 250$ MHz)
- **Radiated Power** 10 dBm (EIRP)
- **Antenna Characteristic** $\pm 30^\circ$ Azimuth, $\pm 15^\circ$ Elevation
- **Dimensions** e.g. 60 x 45 x 20 mm
- **Interface** USB or CAN Bus

Main Advantages

- **Low Cost Technology**
due to use of
 - LTCC standard thickfilm multilayer ceramic and screen-printing process
 - Single chip diodes and transistors instead of MMIC
- **Compact Size**
thanks to
 - Integration of antenna and frontend on one multilayer substrate
 - Compact 3D RF components and interconnects
- **Robust**
against
 - Shock, Vibration, Temperature Extremes



DuPont 951

PRICE M Work Breakdown Structure (WBS)

PRICE Estimating Suite 2004(2004147)

Page 1 of 1

PRICE Estimating Suite 2004 - [c:\price\24 ghz fmcw radar sensor module.hpr]

0	sys	Independent Cost Analysis LTCC Short Range Radar Sensor (IMST,Kamp-Lintfort -D)	WL	Esc	Gb	Esc	Fin	Dep
1		DP - Radar 010 Module	WL	Esc				

Note: Module contains PRICE M estimated IF – Amplifier OP213

DP – Radar 010 Module Input Parameters

Module [X]

Validate Notepad Override Reset Database Schedule Help OK Cancel

Module ID: Calibration Run

DP - Radar 010 Module

QTY		PROTOS		LENGTH		WIDTH		LAYERS	
100000		10.00		3.400		2.100		5	
BTYPE	BSIDES	BWT		BCOST		PTYPE	PPINS	PWT	
4.00	1.0	0.000000		0.00		0.00	14	0.000000	
PLTFM		INTEGE	HSINT	WT		VOL		LOTQTY	
0.900		0.3000	0.20	0.000000		0.00000		10000	
ECMPLX		NEWDES	DESRPT	ACOST		TEST COST		PKCOST	
1.00		0.900	0.000	0.00		0.00		0.00	
DSTART	DFPRO	DLPRO	DBINDX	PSTART	PFAD	PEND	MBINDX	MAUTO	MMAT
106	0	0	10.000	906	0	0	10.000	1.000	1.000
YRTECH	AUCOST	ETCOST	PRCOST	COST TYPE		YRBASE			
0	0.00	0.00	0.00	As Spent		2004			

CNAME [Qty] [Database] Component Qty Estimated Components

SMT sm chip caps [8] [Database2]	1	IF Amplifier OP213
SMT sm chip resistors [9] [Database2]		
SMT lg chip caps [1] [Database2]		
SMT md chip caps [5] [Database2]		
Diode [1] [Database2]		
Transistor [1] [Database2]		

Buttons: Add New, Delete, Modify

Input Form

DP 10 Radar Module Estimating Database

Name	Elements	Type	Package	Pins	Weight	Cost - PRICE M	Cost	Platform	Year
CELM		CTYPE	CPKG	CPINS	CWT	CCOST	CPERQ	Plat	YRBA
IF Amplifier	10	9	8	8	0.00055*	82.09*	0	0.6	2004
SMT sm chip caps	0.75	0.5	0.6	2	0.00055*	2.66*	0	1.2	2004
SMT sm chip resistors	0.75	0.4	0.35	2	0.00055*	1.8*	0	1.2	2004
SMT lg chip caps	0.75	0.5	0.6	2	0.00055*	2.66*	0	1.2	2004
SMT md chip caps	0.75	0.5	0.6	2	0.00055*	2.66*	0	1.2	2004
Diode	1	5	0	2	0.00055*	7.15*	0	0.9	2004
Transistor	1	5	0	3	0.00055*	7.15*	0	0.9	2004
Connector	1	,4	0	14	0.00055*	0.5	0	0.9	2004

* = Estimate from PRICE M

IF Amplifier OP213 Microcircuit Inputs

Microcircuit
✕

Validate
Notepad
Reset
Help
OK

Cancel

Micro. ID:
 Calibration Run
QTYNHA
CDFRAC

IF Amplifier OP213
1
0.00

QTY		PROTOS		LENGTH		WIDTH	PINS	GATES	XSTRS
100000		100.00		0.300		0.300	14	0	50
DPLTFM	SPLTFM	DINDEX	ECMPLX	NEWCEL	DESRPT	CADFAC	ITERAT		
1.200	1.200	9.000	1.00	0.000	0.000	2.000	0.000		
PROFAC		MINDEX	PKGFACT	SUBFAC	WSIZE	FSIZE			
7.000		8.000	0.700	1.000	200	0.500			
CPYLD	ASMYLD	OVLYLD	MSKLVL	DEFDEN	MAUTO	MMAT			
0.000	0.000	0.000	0.000	0.000	1.000	1.000			
DSTART	PTSTRT	PTEND	TSTEND	DEND					
106	0	0	0	0					
PSTART	PPEND	PEND	LOTQTY						
1006	0	0	0						
AUCOST	SPCOST	DSCOST	ETCOST	COST TYPE		YRBASE			
0.00	0.00	0.00	0.00	As Spent		2004			

Total Cost of Development and Production – all costs in K RMB

Basic Estimate (Metric)			
Cost Summary	LM Totals	LM Production	LM Development
Independent Cost Analysis LTCC Short Range Radar Sensor (IMS)			
Wed August 10 2005 11:24 PM (PRICE Estimating Suite 2004)			
System Cost Summary		Costs in (CNY1000 Constant 2004)	
Program Cost	Development	Production	Total Cost
Engineering			
Draft	7.5	0.7	8.2
Design	28.1	2.0	30.2
System	3.0	-	3.0
Proj. Mgmt.	6.2	499.4	505.6
Data	2.2	116.0	118.1
SubTotal(ENG)	47.0	618.2	665.1
Manufacturing			
Production	-	10190.5	10190.5
Prototype	7.2	-	7.2
Tool Test Eq.	0.4	1807.8	1808.2
SubTotal(MFG)	7.6	11998.3	12005.9
G & A / CoM	0.0	0.0	0.0
Fee / Profit	0.0	0.0	0.0
Total Cost	54.5	12616.5	12671.0
System Total	54.5	12616.5	12671.0
Schedule Start	Jan 06 [4]	Sep 06 [3]	
First Item	Apr 06 [2]	Nov 06 [13]	
Finish	Jun 06 [6]	Dec 07 [16]	
System Weight	0.02	System WS	0.00
System Series MTBF Hrs	166905	Unit Sys Cost	0.10
System Quantity	100000	Avg System Cost	0.13

Labor and Material Totals – all costs in K RMB

Basic Estimate (Metric)						
Cost Summary		LM Totals		LM Production		LM Development
Independent Cost Analysis LTCC Short Range Radar Sensor (IMS)						
Wed August 10 2005 11:24 PM (PRICE Estimating Suite 2004)						
System Cost Summary			Costs in (CNY1000 Constant 2004)			
Program Cost	Labor Hrs	Labor	Mat/VODC	Total		
Engineering						
Draft	24.7	8.2	0.0	8.2		
Design	78.7	30.2	0.0	30.2		
System	6.8	3.0	0.0	3.0		
Proj. Mgmt.	1014.4	445.5	60.1	505.6		
Data	173.8	55.5	62.7	118.1		
SubTotal(ENG)	1298.5	542.4	122.7	665.1		
Manufacturing						
Production	13890.6	3571.6	6618.9	10190.5		
Prototype	20.5	6.8	0.4	7.2		
Tool Test Eq.	801.8	289.4	1518.8	1808.2		
SubTotal(MFG)	14713.0	3867.8	8138.0	12005.9		
G & A / CoM				0.0		
Fee / Profit				0.0		
Total Cost	16011.5	4410.3	8260.7	12671.0		
System Total				12671.0		
	Schedule Start	First Item	Finish			
LM Development	Jan 06 [4]	Apr 06 [2]	Jun 06 [6]			
LM Production	Sep 06 [3]	Nov 06 [13]	Dec 07 [16]			
System Weight	0.02	System WS	0.00			
System Series MTBF Hrs	166905	Unit Sys Cost	0.10			
System Quantity	100000	Avg System Cost	0.13			

Labor and Material Production – all costs in K RMB

Basic Estimate (Metric)				
Cost Summary		LM Totals	LM Production	LM Development
Independent Cost Analysis LTCC Short Range Radar Sensor (IMS Wed August 10 2005 11:24 PM (PRICE Estimating Suite 2004))				
System Cost Summary		Costs in (CNY1000 Constant 2004)		
Program Cost	Labor Hrs	Labor	Mat/VODC	Total
Engineering				
Draft	2.2	0.7	0.0	0.7
Design	5.3	2.0	0.0	2.0
System	-	-	-	-
Proj. Mgmt.	1003.4	440.7	58.8	499.4
Data	169.5	54.1	61.9	116.0
SubTotal(ENG)	1180.5	497.6	120.6	618.2
Manufacturing				
Production	13890.6	3571.6	6618.9	10190.5
Prototype	-	-	-	-
Tool Test Eq.	801.4	289.2	1518.6	1807.8
SubTotal(MFG)	14692.1	3860.9	8137.4	11998.3
G & A / CoM				0.0
Fee / Profit				0.0
Total Cost	15872.5	4358.4	8258.0	12616.5
System Total				12616.5
	Schedule Start	First Item	Finish	
LM Production	Sep 06 [3]	Nov 06 [13]	Dec 07 [16]	
System Weight	0.02	System WS	0.00	
System Series MTBF Hrs	166905	Unit Sys Cost	0.10	
System Quantity	100000	Avg System Cost	0.13	

Labor And Material Development – all costs in K RMB

Basic Estimate (Metric)				
Cost Summary		LM Totals	LM Production	LM Development
Independent Cost Analysis LTCC Short Range Radar Sensor (IMS)				
Wed August 10 2005 11:24 PM (PRICE Estimating Suite 2004)				
System Cost Summary		Costs in (CNY1000 Constant 2004)		
Program Cost	Labor Hrs	Labor	Mat/VODC	Total
Engineering				
Draft	22.5	7.5	0.0	7.5
Design	73.4	28.1	0.0	28.1
System	6.8	3.0	0.0	3.0
Proj. Mgmt.	11.1	4.9	1.3	6.2
Data	4.3	1.4	0.8	2.2
SubTotal(ENG)	118.0	44.9	2.1	47.0
Manufacturing				
Production	-	-	-	-
Prototype	20.5	6.8	0.4	7.2
Tool Test Eq.	0.4	0.1	0.2	0.4
SubTotal(MFG)	20.9	7.0	0.6	7.6
G & A / CoM				0.0
Fee / Profit				0.0
Total Cost	138.9	51.8	2.7	54.5
System Total				54.5
	Schedule Start	First Item	Finish	
LM Development	Jan 06 [4]	Apr 06 [2]	Jun 06 [6]	
System Weight	0.02	System WS	0.00	
System Series MTBF Hrs	166905			
System Quantity	100000			

In summary:

- Using parametrics and the PRICE model can provide you with quick, accurate, unbiased, and repeatable tool to estimate your semiconductor chips and microelectronics modules with PRICE M.
- In our demonstration example we have seen that with limited technical information it is possible to estimate state of the art modules to be manufactured in the Peoples Republic of China .

谢谢

