PROCESS SPECIFICATION

REVISIONS					
Rev	**Change Description**	**Release Date**	**Approvals**		
			Eng.	**Q.A.**	**Test/MFG**
P	Revised per ECO 7100	4/08/02 J.S.	-- see below --		
R	Per ECO 7782, Added Paragraphs 2.2.4, 2.4.3, and 2.5.3 Revised Paragraphs 2.5.1 and 2.5.2	12/21/04	G.N.	S.E.	R.G.
T	Revised per ECO 8569	K.R 11/27/06.	G.N.	N.S.	R.G.
U	Revised per ECO 8981 (Administrative Changes)	K.R. 4/30/07	R.S.	N.S.	S.O.
V	Revised per ECO 9600 (Paragraph 2.5 to comply with MIL-DTL-5541.)	K.R. 5/26/09	G.N. 5/26/09	S.L. 5/26/09	R.G. 5/26/09
W	Revised per ECO 9937 (Paragraph 2.4.3, Low PIM Application)	K.R. 10/44/10	G.N. 9/30/10	A.A. 9/30/10	J.L. 10/04/10
Y	Added Gold Plating inspection Requirements	K.R. 3/14/11	G.N. 3/14/11	S.L. 3/14/11	J.L. 3/14/11
AA	Added Low PIM plating specs (Paragraphs 2.1.4, 2.1.5, 2.1.6, and 2.2.5. Revised 2.4.3. Added Post Bake Requirements Paragraph 1.5.)	KR 2/6/13	GN 1/31/13	SL 2/5/13	JW 2/6/13
AB	Removed reference to IPA in paragraph 1.4.2.6 and added paragraph 2.4.4.	KR 9/19/14	GN 9/19/14	GW 9/1914	JL 9/19/14
AC	Revise Per Current Plating Specifications	KR 2/4/16	GN 2/2/16	GW 2/4/16	PJ 2/4/16
AD	Revise Electroless Nickel Plating of Aluminum, 2.2.1	KR 12/20/16	GN 12/19/16	SL 12/19/16	RG 12/20/16
AE	Remove solderability requirement from para 2.2.1 and add paragraph 2.2.6 with solderability requirement	SL 7/08/20	GN 7/07/20	SL 7/08/20	DL 7/08/20

DOW KEY MICROWAVE CORPORATION EXPORT CONTROLLED INFORMATION

This information is subject to the controls of the Export Administration Regulation (EAR). This information shall not be provided to non-U.S. persons or transferred by any means to any location outside the United States without advanced permission from Dow Key Microwave and approval from the United States Department of Commerce.

DOW KEY MICROWAVE CORPORATION PROPRIETARY INFORMATION

The information herein is confidential and proprietary. No Disclosure, reproduction, or further Dissemination may be made without expressed written consent of Dow-Key Microwave Corp.

APPROVAL SIGNATURES:	DATE:
Prepared By: J. SPENCER	04/03/02
Engineering: C. BURAU	04/05/02
Quality Assurance: S. EVERETT	04/04/02
Manufacturing /Test: G. NICKLAUS	04/04/02

APPROVED PLATING PROCESS SPECIFICATION

TABLE OF CONTENTS

1. GENERAL REQUIREMENTS 3
1.1 SCOPE 3
1.2 SUPPLIER QUALITY REQUIREMENTS 3
1.3 INSPECTION AND TEST 3
1.4 INSPECTION CRITERION FOR GOLD PLATED CONTACTS 3
1.5 STANDARD POST BAKE REQUIREMENTS 4
2 FINISH PROCESSES 4
2.1 GOLD PLATE 4
2.2 ELECTROLESS NICKEL PLATE 6
2.3 NICKEL PLATE 7
2.4 SILVER PLATE 7
2.5 CHEMICAL CONVERSION COAT 8
2.6 PASSIVATION 8
2.7 HARD ANODIZE 8
2.8 TIN PLATE 8
2.9 ZINC PLATE 9
3 DRY FILM LUBRICATION PROCESSES 9
3.1 DICRONITE PROCESS – TUNGSTEN DISULFIDE 9
3.2 MICROSEAL PROCESS – TUNGSTEN DISULFIDE 9
4 INSULATION PROCESSES 9
4.1 ALUMINUM ALLOY COIL BOBBINS – LOW FRICTION SOLENOID APPLICATIONS 9

1. General Requirements

1.1 Scope

This specification defines the standard finishes used by Dow-Key Microwave. These finishes must be applied as specified unless otherwise noted on the purchase order and / or drawing. Parts processed in accordance with this specification are used in precision electromechanical devices and the finishes must be of extremely high quality. Any questions or concerns about achieving a high quality finish must be brought to the attention of Dow-Key Microwave Engineering before processing the parts.

1.2 Supplier Quality Requirements

1.2.1 Certificate of Conformance

The supplier must provide a certificate of conformance stating full compliance to the requirements of the purchase order, the drawing and revision letter and this specification including revision letter and applicable paragraph.

1.3 Inspection and Test

The supplier is responsible for all inspections and tests listed within the specification stated on the purchase order and / or drawing.

1.4 Inspection criterion for Gold plated contacts.

1.4.1 Applicability

Requirements specified herein are applicable to the make and break contacting surfaces of parts that are Gold plated for the specific purpose of providing low resistance electrical connections (< 2 milliohms). Examples of such parts include:

1.4.1.1 RF reeds / RF blades
1.4.1.2 RF connector center conductors (both ends)
1.4.1.3 Indicator circuit leafs, blades, contacts and wires

1.4.2 Requirements

The make and break contacting surfaces of Gold plated parts must meet the following requirements:

1.4.2.1 Geometry must be in accordance with drawing requirements.
1.4.2.2 Plating must be in accordance with drawing requirements.
1.4.2.3 Surface finish must be in accordance with drawing requirements.
1.4.2.4 Edge conditions and burr removal must be in accordance with drawing requirements.
1.4.2.5 Plating must not show evidence of blisters, cracks, nodules, voids, chips and/or peeling at up to 10X magnification.
1.4.2.6 Surface finish must not show evidence of contamination and/or discoloration at up to 10X magnification, which cannot be readily removed.
1.4.2.7 Packaging must be sufficient to preclude contamination and/or damage during handling, transit and storage.

1.4.3 Exceptions

These requirements do not apply to the surfaces of Gold plated parts that are intended for crimp or solder connections.

1.5 Standard Post Bake Requirements

This note applies to any part that is Dow-Key Microwave design.

All metallic parts that are plated with Gold, Silver, Copper, electroless Nickel and/or electro-deposited Nickel, individually or in any combination, shall be subjected to a post plating bake process unless otherwise specified. Bake temperature and duration for the various material combinations are specified in Table 1.

Table 1: Post Plating Bake Requirements

Finish	Base Material	Bake Temperature	Bake Duration
Individually or in any combination of Gold, Silver, Copper, Electro less Nickel and/or Electro-deposited Nickel	Aluminum	250 ± 10°F	60 to 90 minutes
	Copper/Brass	300 ± 10°F	60 to 90 minutes
	Iron/Steel	350 ± 15°F	60 to 90 minutes
	Iron/Steel over Rc40	375 ± 10°F	

Note: The supplier's certification of conformance shall state the post plating bake times, and temperature.

2 Finish Processes

2.1 Gold Plate

2.1.1 Copper Beryllium Alloys – RF Connector Center Pins

Gold Plate per ASTM B488, Type I, Grade C, .00010 / .00015 thick over Nickel Plate per SAE-AMS-QQ-N-290, Class 1, .00005 / .00015 thick over Copper Flash (Optional) per SAE AMS 2418, .00001 / .00005 thick. Total plating thickness .00016 / .00035. No Gold Brighteners Permitted.

Note: To control the porosity of the gold plating, the current density of the plating bath must be limited to 1.5 amperes per square foot maximum for the type I gold.

2.1.2 Copper Beryllium Alloys – RF Blades

Gold Plate per ASTM B488, Type III, Grade A, .00005 / .00010 thick over Gold Plate per ASTM B488, Type I, Grade C, .00005 / .00010 thick over Nickel Plate per SAE-AMS-QQ-N-290, Class 1, .00005 / .00015 thick over Copper Flash (Optional) per SAE AMS 2418, .00001 / .00005 thick. Total plating thickness .00016 / .00040. No Gold Brighteners Permitted.

Note: To control the porosity of the gold plating, the current density of the plating bath must be limited to 1.5 amperes per square foot maximum for the type I gold and 0.5 amperes per square foot maximum for the type III gold.

2.1.3 Aluminum Alloys

Gold Plate per ASTM B488, Type I, Grade C, .00010 / .00015 thick over Electroless Nickel Plate per SAE AMS 2404 (Low Phosphorus 2% to 8%), .00020 / .00030 thick over Zincate (double dip) per ASTM B253. The total plating thickness is .00030 / .00045.

2.1.4 Copper Beryllium Alloys – Specialty Plating, Low PIM

RF Connector Shells and Center Pins

Gold Plate per ASTM B488, Type I, Grade C, .00010 / .00015 thick over Nonmagnetic Electroless Nickel Plating (no Electrolytic Nickel Plating or Strike allowed) per ASTM-B733, Type V, Class 5, .00005/.00010 thick. The Electroless Nickel plating bath composition, PH, temperature of the solution, and bath age must be controlled to achieve Phosphorus content 11.2% - 12.5%.

Notes:

In order to achieve optimum nonmagnetic properties of the Nickel plating the following plating bath controls are recommended:

- Plating Phosphorus Content 12% - 12.5% should be targeted in order to ensure nonmagnetic plating properties
- Plating Bath PH Range - 4.6 – 4.8
- Plating Bath Temperature - 87^0C±$0.5C^0$

2.1.5 Copper Beryllium – RF Blades, Specialty Plating, Low PIM

Gold Plate per ASTM B488, Type III, Grade A, .00005 / .00010 thick over Gold Plate per ASTM B488, Type I, Grade C, .00005 / .00010 thick over Nonmagnetic Electroless Nickel Plating (no Electrolytic Nickel Plating or Strike allowed) per ASTM-B733, Type V, Class 5, .00005/.00010 thick. The Electroless Nickel plating bath composition, PH, temperature of the solution, and bath age must be controlled to achieve Phosphorus content 11.2% - 12.5%.

Notes:

In order to achieve optimum nonmagnetic properties of the Nickel plating the following plating bath controls are recommended:

- Plating Phosphorus Content 12% - 12.5% should be targeted in order to ensure nonmagnetic plating properties
- Plating Bath PH Range - 4.6 – 4.8
- Plating Bath Temperature - 87 ± 0.5 ^{0}C

2.1.6 Aluminum Alloys – Specialty Plating, Low PIM

Gold Plate per ASTM B488, Type I, Grade C, .00010 / .00015 thick over Nonmagnetic Electroless Nickel Plating (no Electrolytic Nickel Plating or Strike allowed) per ASTM-B733, Type V, .00005/.00010 thick. The Electroless Nickel plating bath composition, PH, temperature of the solution, and bath age must be controlled to achieve Phosphorus content 11.2% - 12.5%.

Notes:

In order to achieve optimum nonmagnetic properties of the Nickel plating the following plating bath controls are recommended:

- Plating Phosphorus Content 12% - 12.5% should be targeted in order to ensure nonmagnetic plating properties
- Plating Bath PH Range - 4.6 – 4.8
- Plating Bath Temperature - 87 ± 0.5 ^{0}C

2.2 Electroless Nickel Plate

2.2.1 Aluminum Alloys

Electroless Nickel Plate per SAE AMS 2404 (Low Phosphorus 2% to 8%), .00045 / .00055 thick over Zincate (double dip) per ASTM B253.

2.2.2 Magnetic Iron / Low Carbon Steel Alloys

Electroless Nickel Plate per SAE AMS 2404 (Low Phosphorus 2% to 8%), .00020 / .00030 thick.

2.2.3 Copper Alloys

Electroless Nickel Plate per SAE AMS 2404 (Low Phosphorus 2% to 8%), .00045 / .00055 thick.

2.2.4 Aluminum Alloy

Applications requiring nonmagnetic nickel for optimum insertion loss.

Electroless Nickel Plate with High Phosphorus (Greater than 11.2%) Non Magnetic Properties per ASTM-B733, TYPE V, .00045 / .00055 thick over Zincate (double dip) per ASTM B253. No electrolytic Nickel plating or strike allowed.

2.2.5 Aluminum Alloy - Specialty Plating, Low PIM

Electroless Nickel Plate with High Phosphorus (Greater than 11.2%) Non Magnetic Properties (no Electrolytic Nickel Plating or Strike allowed) per ASTM-B733, Type V, .00005/.00010 thick. The Electroless Nickel plating bath composition, PH,

temperature of the solution, and bath age must be controlled to achieve Phosphorus content 11.2% - 12.5%.

Notes:

In order to achieve optimum nonmagnetic properties of the Nickel plating the following plating bath controls are recommended:

- Plating Phosphorus Content 12% - 12.5% should be targeted in order to ensure nonmagnetic plating properties
- Plating Bath PH Range - 4.6 – 4.8
- Plating Bath Temperature - 87 ± 0.5 ^{0}C

2.2.6 Aluminum Alloys – Requiring Soldering

Electroless Nickel Plate per SAE AMS 2404 (Low Phosphorus 2% to 8%), .00045 / .00055 thick over Zincate (double dip) per ASTM B253.

Surfaces shall meet solderability requirements per MIL-STD-202, method 208H

Composition of plating must comply with RoHS requirements per Directive 2011/65/EU

2.3 Nickel Plate

2.3.1 Magnetic Iron / Low Carbon Steel Alloys

Nickel Plate per SAE-QQ-N-290, Class 1, Form SB, .00020 / .00030 thick.

2.3.2 Magnetic Iron / Low Carbon Steel Alloy - Applications requiring ductile (soft) finish.

Nickel Plate per SAE-QQ-N-290, Class 1, Form SD, .00020 / .00030 thick.

2.4 Silver Plate

2.4.1 Copper Alloys

Silver Plate per ASTM B700, Type II, Grade D, Class S, .00030 / .00040 thick over Electroless Nickel Plate per SAE AMS 2404 (Low Phosphorus 2% to 8%), .00005 / .00015 thick over Copper Flash per SAE AMS 2418, .00001 / .00005 thick. Total plating thickness .00036 / .00060.

2.4.2 Aluminum Alloys

Silver Plate per ASTM B700, Type II, Grade D, Class S, .00030 / .00040 thick over Electroless Nickel Plate per SAE AMS 2404 (Low Phosphorus 2% to 8%), .00005 / .00015 thick over Zincate (double dip) per ASTM B253. Total plating thickness .00035 / .00055.

2.4.3 Aluminum Alloys – Specialty Plating, Low PIM

Silver Plate per ASTM B700, Type II, Grade D, Class S, .00030 / .00040 thick over Electroless Nickel Plate with High Phosphorus (Greater than 11.2%) Non Magnetic Properties (no Electrolytic Nickel Plating or Strike allowed) per ASTM B733, Type V, .00005/.00010 thick. The Electroless Nickel plating bath composition, PH, temperature of the solution, and bath age must be controlled to achieve Phosphorus content 11.2% - 12.5%.

Notes:
In order to achieve optimum nonmagnetic properties of the Nickel plating the following plating bath controls are recommended:

- Plating Phosphorus Content 12% - 12.5% should be targeted in order to ensure nonmagnetic plating properties
- Plating Bath PH Range - 4.6 – 4.8
- Plating Bath Temperature - 87 ± 0.5 ^{0}C

2.4.4 Aluminum Alloys

Applications requiring nonmagnetic nickel for optimum insertion loss.

Silver Plate per ASTM B700, Type II, Grade D, Class S, .00030 / .00040 thick over Electroless Nickel Plate with High Phosphorus (Greater than 11.2%) Non Magnetic Properties per ASTM-B733, Type V, .00005/.00015 thick over Zincate (double dip) per ASTM B253. Total plating thickness .00035 / .00055.

2.5 Chemical Conversion Coat

2.5.1 Aluminum Alloys - Electrical applications requiring low resistance

Chemical Conversion Coat per MIL-DTL-5541, Type I, Class 3 (Gold).

2.5.2 Aluminum Alloys – Non-Electrical applications

Chemical Conversion Coat per MIL-DTL-5541, Type I, Class 1A (Gold).

2.5.3 Aluminum Alloys – Special applications requiring a clear finish.

Chemical Conversion Coat per MIL-DTL-5541, Type I, Class 3 (Clear).

2.5.4 Aluminum Alloys – Special applications requiring ROHS Compliance.

Chemical Conversion Coat per MIL-DTL-5541, Type II, Class 1A (Clear).

2.6 Passivation

2.6.1 Stainless Steel Alloys

Passivate per ASTM A967, SAE AMS 2700, or equivalent.

2.7 Hard Anodize

2.7.1 Aluminum Alloys

Anodize per Mil-A-8625, Type III, Class 1, .0020 / .0025 thick. (Hard Anodize, non-dyed)

2.8 Tin Plate

2.8.1 Copper / Copper Alloys

Tin Plate per ASTM-B545 .00020/.00030 thick, Bright Finish, Solderability required.

2.8.2 Deleted

2.9 Zinc Plate

2.9.1 Magnetic Iron / Low Carbon Steel Alloys

Zinc Plate per ASTM B633, Type II, .00020 / .00030 thick.

3 Dry Film Lubrication Processes

3.1 Dicronite Process – Tungsten Disulfide

Dry Film Lubricate per Dicronite DL-5 process.

Suggested Source:
Dicronite Drylube/Rotary Company
816 East Edna Place
Covina, CA 91723
(626) 967-3729

3.2 Microseal Process – Tungsten Disulfide

Dry Film Lubricate per Microseal 300-1 process.

Suggested Source:
EM Coating Solutions
6940 Farmdale Avenue
North Hollywood, CA 91605
(818) 983-1952

4 Insulation Processes

4.1 Aluminum Alloy Coil Bobbins – Low Friction Solenoid Applications

Hardtuf X20 Anodize per Mil-A-63576, .0018 / .0020 thick.

Suggested Source:
Tiodize
15701 Industry Lane
Huntington Beach, CA 92649
714-902-0511
www.tiodize.com