

ENGINEERING INSTRUCTIONS

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E.I. NO ... YM19.....
1 of 2

FOREMAN JMS

JH JT

SHEET NO

CHIEF INSPECTOR W.J.A.

RECORD MC

TITLE GENERAL BUILD STANDARD - SAW DEVICES
BOND STRENGTH TEST

SCOPE To provide standard quality audit procedure for the monitoring of wire bonding.

PARTS Bonded devices.

- EQUIPMENT
1. Bond strength microtester MCT 20 fitted with stereo zoom microscope X14 thru X60 magnification. For use refer to EI YR10.
 2. Stereo zoom microscope - X20 thru X140.
 3. Bond strength record sheet.

PRECAUTIONS 1. Use static lead when handling static sensitive devices.

PROCEDURE BOND STRENGTH TEST

1. Reset printer to Zero and load device in the appropriate chuck.
2. Set load rate knob and set machine to destruct mode.
3. Check load setting on machine is set to the required specification as shown in Table 1.
4. Adjust the microscope to focus on the centre of the device.
5. Determine the first wire to be tested. Carefully lower test hook until it is in focus, but still above the wire to be tested.
6. Lock chuck into position and using extreme care lower hook underneath wire by manipulating the paddle control and set lower limit.
7. Press test button and observe reading.
8. Repeat 5-7 on the specified number of wires to be pulled (See frequency)
9. Press print header switch to record details of device, Batch number, Date, bonder machine number and frequency of print-out obtained from machine.
10. Inform Engineer/Technician if one or more wires fall on or below the load figure specified.

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Litho No: 454

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GEC RESEARCH LABORATORIES
HIRST RESEARCH CENTRE
WEMBLEY MIDDLESEX HA9 7PP

Laboratory Report No: 17029/MS
Author: B R Brown
For : Piezoelectric Technology
Date : 19 April 1984

MATERIALS SCIENCE LABORATORY
MATERIALS CHARACTERISATION DIVISION

ORIENTATION DETERMINATION OF TWO LITHIUM NIOBATE SLICES

Abstract

Orientation measurements on lithium niobate substrate slices for SAW devices confirmed that the samples were Y-cut $\{10\bar{1}0\}$. A Hilger and Watts Y130 Quartz Crystal Goniometer was used.

Measurements on the edge perpendicular to the Z $\langle 0001 \rangle$ direction gave deviations within $20'$ for one slice and $1^{\circ}25'$ for the other slice. Accuracy would be limited by the flatness of the edge measured. A special stage could be constructed for the edge determination if required.

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EXHIBIT No. 3 (CTD.)

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MATERIALS SCIENCE LABORATORY

MATERIALS CHARACTERISATION DIVISION

Laboratory Report No: 17029/MS

B R Brown

Date : 19 April 1984

For : Piezoelectric Technology

Approved by:
C Dineen

ORIENTATION DETERMINATION OF TWO LITHIUM NIOBATE SLICES

1 Introduction

Lithium Niobate of suitable quality is being assessed as a substrate material for SAW devices. Criteria affecting the electrical performance of the completed devices are being established. Samples are being characterised in order to study the influence of substrate quality and orientation on electrical parameters (Report to be issued).

Two lithium niobate slices were received; nominally Y-cut, with a flat edge cut perpendicular to the Z axis. The slices were later sectioned into rectangles with the long edge parallel to the Z axis.

It was required to check the orientation of the slice surface and the perpendicular to the flat.

2 Method and Results

Orientation measurements were made using a Hilger and Watts Y130 Quartz Crystal Goniometer calibrated to read to 1'. A standard stage was used to check the Y-cut orientation. Device material was then cut from the slices and the off-cuts used to determine the direction of the Z-axis relative to the appropriate edge. For this measurement the slice was supported on the standard stage by accurately right angled ($\pm 2'$) glass blocks. This measurement could only be made perpendicular to the long direction of the appropriate edge. Two further measurements perpendicular to each other and at 45° to the long direction of the edge were made using a glass V-groove. Difficulties were encountered due to the shape of the slice.. The results are tabulated.

3 Conclusions and Discussion

The samples were Y-cut $\{10\bar{1}0\}$ ($\pm 12'$).

The accuracy of the measurement of the Z direction is dependent on having a flat edge set perpendicular to the face of the slice and the Z direction. For slice A no deviation $>12'$ was recorded, but for sample B a deviation greater than 1° was obtained. It should be borne in mind that this could relate to the flatness of the edge.

A special stage has been designed (Report No: 15511/MS) for the measurement of trapezium-shaped SAW α -quartz plates. A similar special mount could be constructed for measurements on standard size lithium niobate plate edges if required.

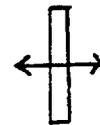
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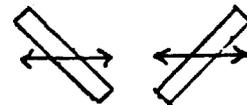
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- ~~Mr D C Lewis~~
- Mr R Peach

Sample	Nominal Orientation of face/edge	Measured deviation from nominal orientation ($\pm 5'$)
Circular Slice (No 3)	Y-cut $\{10\bar{1}0\}$	$0^\circ 5'$
Circular Slice (No 4)	Y-cut $\{10\bar{1}0\}$	$0^\circ 7'$
Cut piece (A) Pos 1	Z $\langle 0001 \rangle$	$\pm 0^\circ 8'$
Cut piece (A) Pos 2	"	$\pm 0^\circ 7'$
Cut piece (A) Pos 3	"	$* 0^\circ 2'$
Cut piece (A) Pos 4	"	$* 0^\circ 10'$
Cut piece (A) Pos 5	"	$* 0^\circ 5'$
Cut piece (A) Pos 6	"	$* 0^\circ 12'$
Cut piece (B) Pos 1	"	$0^\circ 1'$
Cut piece (B) Pos 2	"	$0^\circ 0'$
Cut piece (B) Pos 3	"	$1^\circ 14'$
Cut piece (B) Pos 4	"	$1^\circ 8'$
Cut piece (B) Pos 5	"	$1^\circ 9'$
Cut piece (B) Pos 6	"	$1^\circ 16'$

\pm Measurement \pm to long direction of edge



* Measurement 45° to long direction of edge



16822c

ORIENTATION MEASUREMENTS OF LITHIUM NIOBATE (LiNbO_3) AND α QUARTZ (SiO_2)
SLICES FOR SAW DEVICES

Lithium Niobate Slices

The above Y-cut either rectangular or circular in shape. The long direction of the rectangle defines the Z-axis for the rectangular slices and the direction perpendicular to the flat for the circular slices. The requirement is to check the cut of the slice and the Z-axis direction.

α Quartz Slices

The slices were ST-cut. The requirement is to check the cut and the X-axis direction nominally parallel to one edge.

Orientation Measurements

Angular deviations from the nominal orientation measured using a Hilger & Watts Y130 Quartz Crystal Goniometer calibrated to read to one minute of arc. Determinations are made using a standard stage. For measurements on the edges the sample is supported by accurately right angled ($<2'$) glass blocks or a glass V-groove. Where the geometry of the slice allows measurements are made in two directions at right angles. The accuracy is dependant on the flatness and positioning of the edge. (Ref Report Numbers: 17029/115 and 17027/115)

If required a special stage could be constructed similar to that designed for trapezium shaped ST-quarter SAW plates (Report No: 15511/MS).

The side of the cut (ie AT, ST or BT) for α -quartz samples and correctness of the cut in relation to angular distance from the Z-axis (c-axis) are checked using a standard X-ray Diffraction back reflection Laue technique.

B. BROWN.

MANUFACTURING FLOWCHART

GOODS IN (COC'S REQ'D)



* It is to be determined whether acoustic absorbers req'd.

Substrates

Adhesives

Packages

2)

Orientation & Quality Check

Materials Science Dept.

3)

Preliminary Slice Processing

Optical Surfacing Dept.

4)

Cleaning

5)

Metallisation

6)

Photolithography

(V)

7)

Dice/Taper

(V)

8)

Re-clean

(V)

1)

Preparation & Qualification

9)

Substrate & Acoustic Absorber Mounting

10)

T/C Bonding

11)

1st Electrical Test

12)

Encapsulation

13)

Leak Test

14)

2nd Electrical Test - Select

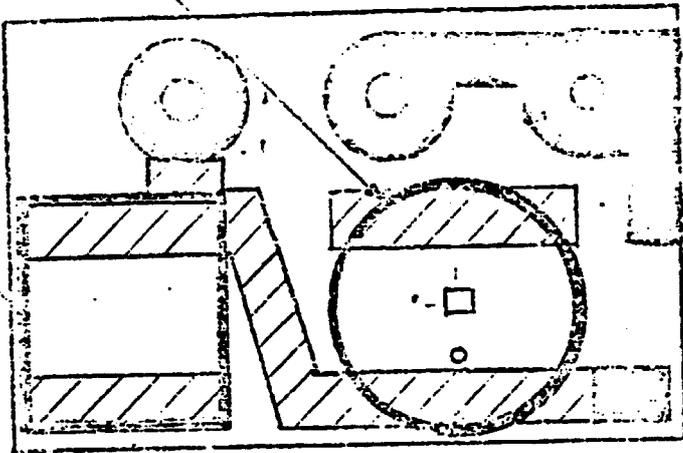
15)

Capability Programme

Trimmer Capacitor

EXHIBIT No. 3 (CTD.)

chip inductor



NOTES

- 1) Boards are supplied both fibre brushed & degreased.
- 2) Trimmer capacitor leads are to be clipped, using an appropriate tool to the shortest possible length.
- 3) Component mounting positions are indicated in thick out-line and should be strictly adhered to.
- 4) The trimmer capacitor must be mounted with the blue dot furthest from the circular contact pads.
- 5) Particular care must be taken to avoid contact between the trimmer capacitor lead tab and the adjacent circular contact pads.
- 6) Areas marked in □-shading must be kept free of solder and, (as far as possible), flux.
- 7) Minimum glass paste quantities are to be used to avoid 'clogging' of the capacitors and over-run of the block-shaded areas.

Handling :- Finger cots must be worn during lead trimming.
Handle only with tweezers at all other times.

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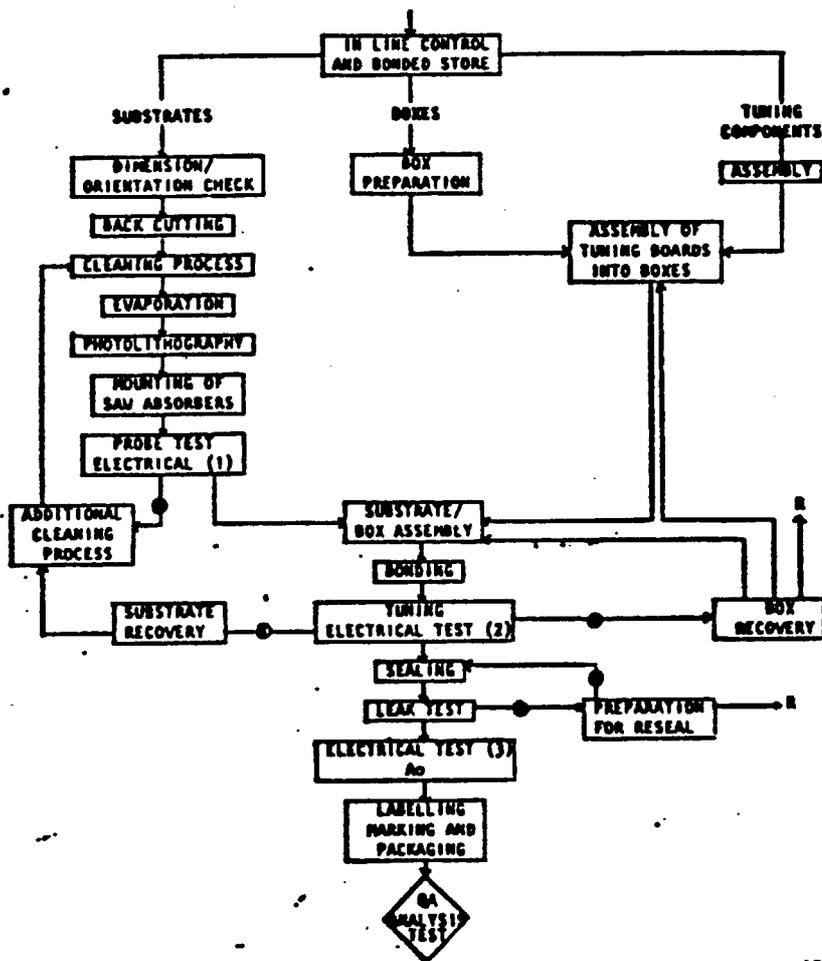
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TITLE

MICROWAVE DIVISION - FLOW DIAGRAM - SAW DEVICES



NOTES

- 1) REFER TO MICROWAVE DIVISION FLOW CHART QAM 001 SECTION 9
- 2) QC/QA GATES ARE SET ON THE INDIVIDUAL LINE BATCH TRAVELLER.

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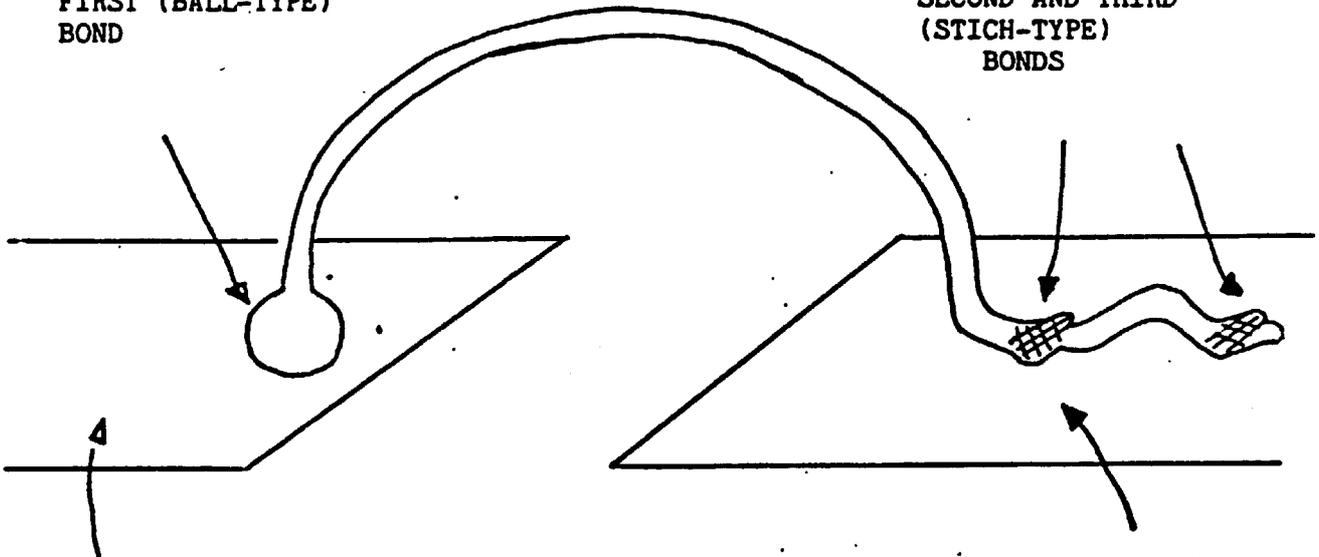
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TITLE GENERAL BUILD STANDARD - SAW DEVICES
THERMOCOMPRESSION BONDING

Electrical connections are made between the summing bars of the transducers and the gold plated circuit board pads by means of triple 0.001" dia. gold wires (a suitable gold wire is MK goldwire 25my available from Dage Intersem Ltd.). The positions and points of contacts of the required bonds are to be found in the device Engineering Instructions.

FIRST (BALL-TYPE)
 BOND

SECOND AND THIRD
 (STICH-TYPE)
 BONDS



GOLD PLATED
 SURFACE E.G.
 P.C.B. PAD

ALUMINIUM PLATED
 SURFACE - E.G.
 TRANSDUCER
 SUMMING BAR

SCHEMATIC DIAGRAM NO.2.

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TITLE GENRAL BUILD STANDARD - SAW DEVICES
THERMOCOMPRESSION BONDING

PROCEDURE (Using Precima TCB21)

- 1) Switch on power supply at mains and press POWER ON button on machine.
- 2) Open nitrogen, hydrogen and vacuum supplies at taps, and press HYDROGEN and TOOL HEAT buttons on machine.
- 3) Set up the operating conditions as follows:-
 - a) Hydrogen flowmeter between 30 and 35 (no units indicated)
 - b) "Temperature" between 8 & 9 for both channels.
 NB A tip temperature of 800 - 900°C as indicated by the panel meter should be obtained when bonding with these conditions.
 - c) "Power" between 8 and 9 for both channels. (No units are indicated)
 - d) "Time" between 5 and 9 for both channels. (No units are indicated).
 - e) "Vibration" on for channel 1 only . (See Note 3).
 - f) "Flame-Off Speed" to give a flame-off cycle time of about 1 second.
- 4) Ignite the hydrogen gas jet using suitable ignition (e.g. a peizoelectronic gas lighter). It may be useful to activate the flame-off control (the right hand lever) and press MOTOR STOP to make the jet nozzle more accessible.
- 5) Press NITROGEN button.
- 6) Place device to be bonded on a suitable mount on the supporting platform below the bonding tip. Ensure that the bonding tip has sufficient freedom of movement to make contact to the points to be connected by suitable adjustment of the left hand joystick control. (Coarse adjustment is achieved by releasing the vacuum to the joystick mount using the microswitch on the mount). Adjust the binocular microscope for optimum viewing conditions of the points to be connected.

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TITLE GENERAL BUILD STANDARD - SAW DEVICES
THERMOCOMPRESSION BONDING

PROCEDURE

- 7) Ensure that the bonding tip is threaded, and that there is a ball of the correct size (about 3 times the diameter of the wire) at the end of the wire. If not, pull a length of wire through the tip using tweezers and flame-off so that the flame cuts the wire at about 3mm from the tip. Keep fingers well away from the flame and the tip.
- 8) When a suitable ball has been obtained, lower the bonding tip using the right hand lever, so that it comes into contact with the area to be connected. N.B. The first bond, or ball bond, is usually made to the gold plated connecting point. Sandwich the ball between the tip and the relevant area of the filter, and fully lower the right hand lever. The tip will now heat automatically, and the workstage illumination will dim for the duration of the bonding cycle. When the cycle is complete, raise the tip a few mm and move the device using the left hand joystick so that a second "stich" bond can be made to the relevant area on the relevant transducer. Again lower the right hand lever and sandwich the wire itself between the tip and the bonding point, allowing the bonding cycle to be completed as before. Raise the bonding tip by a few mm and after suitable manipulation of the joystick, make a second stich bond adjacent to the first. Finally, raise the bonding tip completely and flame-off the trailing gold wire by suitable manipulation of the right hand lever. The flame-off operation activates the "tail puller" which automatically removes the trailing lead emerging from the final stich bond. If this is not operating properly the tails may be carefully pulled manually using tweezers. If at any point in operation 8 the gold wire does not adhere to the relevant surface after the bonding cycle, carefully remove any wire remnants from the area and recommence at operation 7.
- 9) Repeat operation 8 as required for each electrical connection using new contact points on the relevant gold pad or transducer summing bar.

NB

- (i) It may be necessary to gently abraide the relevant gold plated surface prior to bonding using a suitable sharp implement, glass brush, or cleaning with an acetone impregnated tissue.
- (ii) It may be necessary to periodically adjust the bonding conditions outlined in operation 3. E.g. tip temperature or vibration. These may have to be adjusted according to surface conditions.

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BRITISH STANDARD REFERENCE : BS9450 APPENDIX E, MIC-CQC 8
 CERTIFICATE NUMBER :
 MANUFACTURER : GEC LTD, HIRST RESEARCH CENTRE, EAST LANE,
 N WEMBLEY, MIDDLESEX, HA9 7PP
 TEL: 01-904-1262

BASIC TECHNOLOGY Thin Film deposition and delineation
 SUBSTRATES Alumina and spinel
 PATTERN FORMATION Photolithography and etching
 CONDUCTORS Gold
 ASSEMBLY Delay line fitted into metal enclosure with suitable clamps, thin film tuning circuit included in required position and connected and tuned.
 ENCAPSULATION Gasket sealed lidded metal case
 PACKAGE Precision metal container fitted with microwave connector.
 RATINGS Max. power input +20 dBm for 0.5 sec
 Operating temperature range -40°C to +85°C
 Storage temperature range -50°C to +90°C
 Vibration (Operating) 10g 30 Hz to 2 kHz

INSPECTION AND TESTS

SCREENING
ENVIRONMENTAL
BS9450 REFERENCES

Reference 1.2.9 of BS9450

	<u>TEST</u>	<u>TEST CONDITIONS</u>
1.2.6.13	Rapid change of temperature	-26°C to +80°C
1.2.6.5	Damp heat, cyclic	12 cycles, 12 hours each
1.2.6.9	Acceleration, steady state	196 m/s ²
1.2.6.8.1	Vibration, swept frequency	20 to 2000 Hz, 98 m/s ²
1.2.6.6	Shock	490 m/s ² , 11 ms
1.2.6.14.2.1	Sealing	+80°C
1.2.7	Endurance	+85°C (non-operating)
	Bump	4000 bumps of 40g 6 ms

TYPICAL PERFORMANCE Delay of 30 μs at reference frequency of 3 GHz with bandwidth of ±300 MHz and insertion loss of 26 dB.

LEVEL OR STAGE OF CUSTOMER PARTICIPATION IN DESIGN

GUIDANCE TO CUSTOMER DOCUMENT To be published

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E.I. NO ..YM21.....
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TITLE GENERAL BUILD STANDARD - SAW DEVICES
DIMENSION AND ORIENTATION

A sample check (10%) must be carried out on external dimensions, polished surface quality and crystallographic orientation against relevant drawings. See device E1.

1. DIMENSIONS

Check each slice in the sample using an Etalon Micro-Rapid Micrometer (or equivalent), resolution 1 micron, the thickness dimension being checked to be within the specified tolerances. Check the length and width dimensions using a standard micrometer.

2. ORIENTATION

The orientation is checked using a suitable crystal X-ray goniometer using standard procedures to meet the specified requirements; (see device E1) these measurements are comparative about a mean figure and on that basis are self checking. Any possible discrepancies can be checked by reference to HRC's (Hirst Research Centre). Crystallography Department who have apparatus traceable to NPL standards.

N.B. (At present this process is carried out by HRC)

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HIRST RESEARCH CENTRE

DRAFT INSTRUCTION
OCTOBER 1983
A J BYRNE

OPERATION OF DAGE PRECIMA MASK DEEP UV. ALIGNER

The UV lamp power supply operates independently of the aligner controls. The power supply is located under the main aligner table on a separate stand. The aligner controls are situated on RH side of the table.

To switch the lamp on:-

DO NOT alter the variable power controls on the power supply front panel.

1. Switch on the power, using the front panel "power" switch.
2. Press in the red "ignition" button and release. The lamp will light.

If it does not, call for help.

3. Allow the lamp to warm up for 15 mins.
4. Switch the meter to measure the voltage and then the current. Now adjust the variable power control carefully, using the fine control port, so that the product of the voltage and current readings is 350 watts or slightly less.

NB: The adjustment required should be very small, if any.

5. The lamp is now ready for use. The adjustment should be repeated every hour or so of operation.

To operate the aligner:-

6. Switch on the aligner controls by pressing the RED button marked "POWER". With the "Mask Hold" off and the BLACK chuck control knob in the "OFF" position, ensure that there is a least 20 ins. (Hg) of vacuum reading on the gauge. DO NOT operate the aligner if this is not satisfied.
7. Fit a mask holding plate. A plate with a suitable aperture for the mask to be used must be chosen. The plate is removed by undoing the thumb screw at the front and the 2 Allen screws on the hinge piece at

DRAFT INSTRUCTION
OCTOBER 1983
SHEET 2

the rear of the plate. Refitting is the reverse. Note that the small rubber tube must be refitted carefully to the plate tube.

8. Fit a substrate chuck. A chuck of suitable diameter must be chosen such that the rubber sealing ring of the chuck does not overlap the mask edges. However, the smallest chuck which just accommodates the substrate size, is most suitable.

To remove the chuck - rotate the chuck control knob to "level", lift out the chuck with spherical bearing and vacuum and nitrogen lines attached. Carefully remove the lines, noting the position of the line with the red marker (nitrogen) ie. attached to the off-centred pipe. Clip the pipes into the guide pin location pins at the rear of the spherical bearing base to ensure that they do not fall into the central hole. Unscrew the spherical bearing from the chuck.

Refitting of the new chuck is the reverse of the removal procedure. Ensure that the pipes are fitted the correct way round, and that the guide pin is located correctly. Also ensure that the spherical bearing moves freely. Adjust the air supply control on the main control panel to suit.

9. Note that the chuck centre must be adjusted to give the correct substrate surface height, ie. 1mm approximately above the outer metal rim. This is adjusted by slackening the 3 small Allen screws in the centre part of the chuck and rotating the centre with the special adjustable peg spanner. Then tighten the 3 Allen screws.
10. Load the mask. Ensure that the mask has been suitable cleaned. Position the mask, chrome side down, on the underside of the mask

DRAFT INSTRUCTION
OCTOBER 1983
SHEET 3

holding plate, so that the vacuum groove is covered all round. Hold the mask in position with one hand and switch on the "mask hold" button. Ensure that the mask is held securely before removing the supporting hand.

11. Load the substrate.

Move the control knob to "load". Place the resist coated, pre-baked substrate in the centre of the chuck. If the substrate does not cover all the vacuum-hold down grooves - then they must all be covered with insulating tape (sticky side down); however, no vacuum hold for the substrate will then be available. Similarly, if the substrate is 'back cut', the vacuum groove must be covered.

The substrate must have its propagation direction aligned approximately with the direction of the mask pattern. (SAW only)

12. Screw up the mask holder support screw (located at the front LH side of centre of the table) so that the ball bearing is well proud of the support pillar.

13. Lower the mask holder (it is held on an automatic catch and must be raised first). The orange indicator light (next to the chuck control knob) will come on, indicating that the mask is not in contact with the substrate.

IF the pattern to be printed is the first or only layer, proceed as follows:-

14. Using the coarse X,Y and θ micrometer controls, and observing with the naked eye, position the substrate carefully so that the propagation direction of the substrate material is lined up precisely with the propagation direction of the mask pattern (SAW only) and so that the pattern is

suitably placed on the substrate, usually centred. (This is usually achieved by lining up a 'bus' bar of the mask pattern with one of the substrate edges which has been kept carefully oriented with the material propagation direction during previous substrate machining. Then move the pattern to the chosen position on the substrate).

15. Lower the mask holder steadily by screwing down the support screw. When the rubber ring of the chuck just comes into contact with the mask, move the chuck control knob to the 'level' position. Lower the mask holder a little more so that the rubber makes good contact with the mask, but ensure that the orange light is still on - ie. the mask is not in contact with the substrate. Check that the pattern is still correctly aligned on the substrate. Lower the mask completely so that the orange light goes out.
16. Observe the contact fringe pattern and, with light finger pressure, load the mask holder to note the fringe pattern changing. The fringe pattern indicates the quality of contact.
17. Move the chuck control knob to "Align". The fringe pattern should show no more than 6 fringes across the main pattern area. More fringes than this indicate very poor contact and advice should be sort.
18. Move the chuck control to "Expose". The fringe pattern should show no more than 4 fringes across the mask pattern area.
19. Swing the lamp housing over the mask holder, using the red handle attached to the lamp housing arm.

20. Adjust the exposure timer to a suitable time for the resist coating on the substrate.
21. Press the RED button next to the chuck control knob. The shutter will open for the preset time.
22. After the shutter closes swing the lamp away.
Rotate the chuck control knob to "Align".
23. Screw up the mask holder support screw so that the mask is clear of the substrate (orange light on). If the substrate sticks to the mask, raise the holder slightly and gently tap it down onto the support pillar. If the mask still sticks, carefully pull the substrate off the mask
DO NOT: Push the substrate along the surface of the mask.
Dig tweezers between mask and substrate
24. Raise the mask holder onto the automatic catch.
25. Remove the substrate from the chuck. If the substrate is held down by vacuum, rotate the chuck control to "LOAD".
26. Develop the substrate immediately - referring to the suitable process schedule.
27. Repeat from 11. for next substrate.
28. After the final device has been printed, remove the mask, remembering to support mask before switching off "MASK HOLD" vacuum.
29. Switch off lamp power supply but do not alter the variable controls.
30. Switch off the aligner power. Leave the mask holder and chuck in place with the mask holder in the raised position.

4 ABSTRACT FOR INCLUSION IN PD 9002

British Standard Reference : B9450 Appendix E, full assessment level
 Certificate Number :
 Manufacturers : GEC Research Laboratories,
 Hirst Research Centre, East Lane,
 Wembley, Middlesex, HA9 7PP
 Tel No: 01-904-1262

Basic technology : Thin film using Rayleigh mode theory
 Substrate : Quartz or lithium niobate
 Pattern formation : Photolithography and etching
 Conductors : Interdigitated transducers, aluminium
 Assembly : SAW element flexibly fitted in metal enclosure with a suitable adhesive. Add-on components such as printed circuit boards and inductors included in box where required by design
 Encapsulation : Lidded box, compression or seam welded (hermetic)
 Package : Precision metal enclosure (welded sealed)
 Ratings : Maximum power dissipation : 10 mW
 Maximum operating temperature range: -26°C to +80°C
 Operating temperature : +40°C
 Storage temperature : -40°C to +85°C

Inspection and tests

Screening : Reference 1.2.9 of BS9450
 Environmental : Tests, inspection levels as for full assessment level in 1.3.3.1 of BS9450

<u>BS9450 reference</u>	<u>Test</u>	<u>Test condition</u>
1.2.6.1.3	Rapid change of temperature	-26°C to +80°C
1.2.6.5	Damp heat cyclic	6 cycles
1.2.6.9	Acceleration, steady state	196 m/s ²
1.2.6.8.1	Vibration, swept frequency	55 to 2000 Hz, 98 m/s ²
1.2.6.6	Shock	490 m/s ² , 11 ms
1.2.6.1.4	Sealing	As in BS2011, test Qk
1.2.7	Endurance	+85°C (non-operating)

Typical performance : Fast cut-off SAW bandpass filter up to 200 MHz centre frequency. Fractional bandwidth: Quartz : 0.3%
 Lithium: 10%
 niobate approx

Level or stage of customer participation in design:

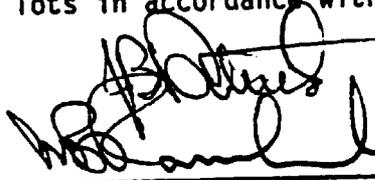
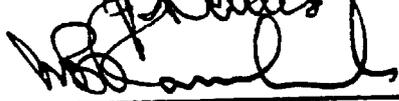
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Guidance to customer document: To be published

CERTIFIED TEST RECORDS

Component manufacturer : GEC Research Laboratories
 Place of manufacture : Hirst Research Centre, East Lane,
 Wembley, Middlesex HA9 7PP
 TEL NO: 01-904-1262
 Detail specification and issue number: BS9450 - SAW-CQC5 - Issue 1
 Description of component : Wideband surface acoustic wave
 filter on lithium-niobate substrate
 in hermetic seal metal case. Centre
 frequency 120 MHz. Full assessment.
 Current five month period : 30th September 1983 to
 28th February 1984
 Date of commencement of current
 3 year period : 30th September 1983

This certified test record is a complete and accurate record of the tests carried out on accepted lots in accordance with the specified procedures.

CHIEF INSPECTOR :  DATE: 28/2/84
 SUPERVISING INSPECTOR: 

SUBGROUP OR TEST	Similar devices during current five months	
	Tested	Defective
A2 (i) Reference frequency	3	0
(ii) Bandwidth	3	0
(iii) Insertion loss	3	0
(iv) Ripple	3	0
B2 (i) Rapid change of temperature	3	0
(ii) Fine leak test	3	0
(iii) Damp heat cyclic	3	0
B4 (i) Acceleration, steady state	3	0
B5 Endurance - 200 hours	3	0
C1 (i) Vibration	3	0
Shock	3	0
(ii) Damp heat, steady state	3	0

THE GENERAL ELECTRIC COMPANY LIMITED

HIRST RESEARCH CENTRE

WEMBLEY, MIDDLESEX

HA9 7PP

EXHIBIT No. 3 (CTD.)

Spec to 13 Jan

MATERIALS SCIENCE DIVISION

MATERIALS CHARACTERISATION DEPARTMENT

Department Report No. 1511/MS

C. Dineen

Date:

Approved by:
B.J. Isherwood

For: D.A.S.

Orientation Measurements on large ST-Cut α -Quartz plates
for Surface Acoustic Wave Device Application

1. Introduction

A requirement has arisen for a facility to be established which will permit orientation measurements to be made on large single crystal plates of ST-cut α -quartz. The plates, which are 2.5mm thick and 15mm wide have a 7.6° bevel at each end (trapezium shaped) and a maximum length of 205mm.

These measurements are required for quality assurance purposes in connection with the manufacture of Surface Acoustic Wave Dispersive Delay Lines. The orientation specifications for these plates are as shown in the figure.

The standard procedures which would normally be employed to determine the orientation of large blocks of single crystal material cannot be applied directly in this instance because of the size and shape of the crystal plates. A modification to the basic procedure has therefore been devised to facilitate the determination of the ST-cut, whilst a new specimen-mounting jig has been designed and manufactured to permit measurement of the position of the x-axis.

This report describes the revised measurement procedures and illustrates the methods employed with results obtained on a large ST-cut α -quartz plate (Z140SK413254, Serial No. 145).

2. Equipment

The equipment used to make the orientation measurements was a Hilger and Watts Y130 quartz crystal orienter, calibrated to read to one minute of arc. The ST-cut determination was made using a standard specimen-mounting stage whilst to facilitate the determination of the angular position of the x-axis a new specimen stage was designed and manufactured. The new specimen stage supports the crystal in a horizontal position and allows the crystal to be rotated about an axis parallel to the long edge of the crystal. Measurements carried out by the Inspection and Calibration Service

at H.R.C. indicate that the angular errors introduced into the orientation determination by a rotation of the plate through 180° are less than 0.3' (minutes) of arc.

3. Orientation Determination

3.1 General Considerations

A number of problems exist with the manufacture and preparation of large single crystal plates. Amongst the more important, from the point of view of the orientation specification are those associated with the distortion of the plate which occurs during the manufacturing process. The effect of this distortion may be illustrated by the consideration of the two extremes which may occur in practice. These are

1. The crystal lattice is undistorted, but the reference surface and edges of the plate do not conform to the flatness specifications.
2. The surface and edge flatness specifications are satisfied, but the crystal lattice is distorted.

The nature of the distortion may vary from a simple uniform deviation of the surface from the desired orientation to a uniform curvature of the crystal lattice or reference surface and edge. The possibility that both forms of distortion may be present must also be considered. The effect of these distortions range in complexity from a simple misorientation angle, which is characteristic of the whole plate, to an angular orientation function which describes the local relationship of adjacent parts of the crystal lattice to the reference surfaces.

This latter measurement is, since it necessitates a detailed study of the entire surface of the crystal, a lengthy procedure. In the context of the present requirement it is proposed that the orientation determination be confined to measurement of the misorientation of the crystal lattice with respect to the reference surface at each end of the plate. Local variations in the orientation of the plate will not be observed, however this procedure should detect excessive curvature or twist, the most likely problems to occur in practice. It should be noted that the orientation error associated with the maximum permissible deviation from flatness specified for these plates would be of the order of 0.5' (minutes) of arc.

In view of the size of these plates and the requirements listed in item 2.1 (1) of the quality assurance specifications it is strongly recommended that an X-ray topographical or other such technique, capable of revealing twinning and other lattice defects, be used to examine these crystals.

3.2 Proposed Experimental Procedure

It will be assumed in the sections which follow that the basic orientation of the plate is correct i.e. that the sense of rotation of the cut is correct and that the angle of rotation is approximately correct. The Laue X-ray diffraction technique may be used to establish the basic orientation of the plate.

/The

The proposed procedure is illustrated in the sections which follow by a description of an orientation determination made on crystal No. Z140SM413254 Serial No. 145.

3.2.1. Determination of the ST-cut orientation

The basic calibration of the crystal orienter, equipped with the standard specimen stage was first established with the aid of a reference block of α -quartz with a known orientation. The orientation of the ST-cut in the plate was then determined using both the $01\bar{1}1$ (Bragg angle $13^{\circ} 19'$ - $\text{CuK}\alpha$) and the $02\bar{2}3$ (Bragg angle $34^{\circ} 4'$ - $\text{CuK}\alpha$) reflections as described below.

1. The plate was mounted vertically with the polished surface in contact with the reference surface on the specimen stage.
2. The X-ray detector was then positioned to receive the diffracted beam and the orientation of the plate adjusted until a diffracted beam was detected.
3. The angular position of the crystal was then noted and used to calculate the orientation of the polished surface.
4. Steps 1-3 were then repeated at the other end of the rod.

The measurements made were as shown below.

End (See figure)	Orientation of Plate		Misorientation w.r.t. the reflector	
	$01\bar{1}1$	$02\bar{2}3$	$01\bar{1}1$	$02\bar{2}3$
A	$8^{\circ} 35'$	$40^{\circ} 58'$	$+ 4^{\circ} 44'$	$-6^{\circ} 54'$
B	$18^{\circ} 6'$	$27^{\circ} 19'$	$+ 4^{\circ} 47'$	$-6^{\circ} 45'$

The theoretically calculated angles between the $01\bar{1}1$ and $02\bar{2}3$ planes and the ST-cut are $4^{\circ} 32'$ and $7^{\circ} 0'$ respectively. The $01\bar{1}1$ and $02\bar{2}3$ planes are effectively rotated Y cuts in which the angles of rotation are $-38^{\circ} 13'$ and $49^{\circ} 45'$ respectively. The angle of the cut at each end of the rod is therefore

End A $42^{\circ} 57'$ ($01\bar{1}1$) & $42^{\circ} 51'$ ($02\bar{2}3$)

End B $43^{\circ} 0'$ ($01\bar{1}1$) & $43^{\circ} 0'$ ($02\bar{2}3$)

The accuracy of each determination is estimated to be $\pm 3'$. The difference in the orientation of the cut at each end of the rod (mean at A $42^{\circ} 54' \pm 3'$, mean at B $43^{\circ} 0' \pm 3'$) is therefore not significant so that we may calculate on average for the four results of $42^{\circ} 57' \pm 3'$.

3.2.2. Orientation of the x-axis

The new crystal mounting stage was fitted to the goniometer and the basic calibration again established using a block of α -quartz of known orientation. The orientation of the x-axis was then determined in the plane of the plate and at right angles to it, at both ends of the plate as indicated below.

1. The crystal was mounted in the plate holder with the polished surface uppermost and horizontal.
2. The position of the detector was adjusted to receive the 1010 reflection and the orientation of the plate adjusted until a reflection was observed.
3. The crystal was then rotated in 90° steps and at each step the orientation of the crystal at which a reflection occurred noted.
4. The crystal was then remounted with the other end of the rod in a position to diffract and the measurements repeated. The results obtained are shown below.

	Position 1	Position 2	Position 3	Position 4
End A	17° 50'	18° 18.5'	18° 45'	18° 15'
End B	17° 50.5'	18° 18'	18° 44'	18° 15'

The means of the values at positions 1 & 3 and 2 & 4 give the Bragg angle for the reflection employed.

	Positions 1 & 3	Positions 2 & 4
End A	18° 17.5'	18° 16.8'
End B	18° 17.3'	18° 16.5'

Since there is no significant difference between this group of angles, we may calculate a mean value from the set as 18° 17' ± 0.2'. The theoretical value is 18° 17'.

The differences in the results obtained at positions 1 & 3 and 2 & 4 give an angle which is twice the orientation error of the x-axis with respect to the major edges of the plate. At end A the axis lies in the plane of the plate to within 2' however in the plane it makes an angle of 27.5' with the major edge. Essentially the same result is obtained at end B. The accuracy of the determination is estimated to be ± 2' of arc.

4. Summary and Conclusions

Procedures have been devised and equipment developed to facilitate orientation measurements on large single crystal, ST-cut plates of α-quartz. The procedures and equipment have been employed to determine the orientation of a typical crystal plate (No. Z140SK413254 Serial No. 145).

The orientation of the ST-cut was found to be 42° 57' ± 4' just within the specification of 42° 45' ± 15'. The x-axis was found to lie in the plane of the plate to within 2' ± 2', but to subtend an angle of 27.5' ± 2' with the long edge of the crystal. The orientation of the x-axis is therefore outside the specification of ± 15'.

Reference

1. Substrate for S.A.W.

Marconi Drawing No. Y331298.

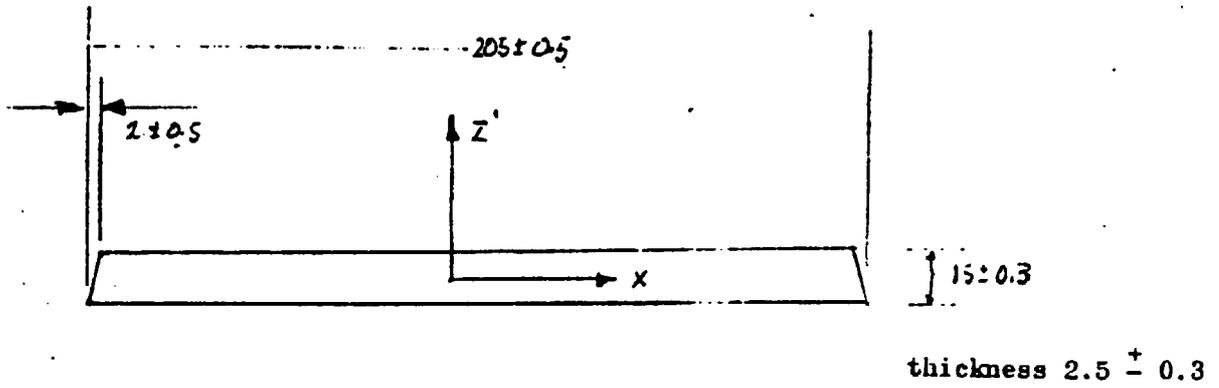
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Correspondence
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S. Radcliffe "

OC

FIGURE
Orientation Requirements



Orientation of the Polished Face.

ST-cut axis Y' rotated $+ 42^{\circ} 45' \pm 15'$ from Y
Each long edge \parallel with axis $- 15'$

All dimensions in millimetres.

ENGINEERING INSTRUCTIONS

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E.I. NO YE 4
 SHEET NO 1 of 2

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TITLE DRILLING AND SAWING OF QUARTZ AND ALUMINA SUBSTRATES
FOR SAW APPLICATIONS
DRILLING (ALUMINA ONLY)

A. For Round Holes

1. Refer to the E.I. for the circuit concerned, to determine the size of hole required and its position on the substrate.
2. Noting this information, the correct drilling machine and type of drill may now be chosen.
 Use the meddings MB10 for holes needing accuracy in position, or for particularly delicate jobs, up to a maximum size of 3.5mm for normal use.
 Use the Micromeccanica for all general drilling up to 3.5mm
 Use the Meddings for holes greater in diameter than 2.5mm.

Note that the drill used may be chosen to suit the job undertaken, and may not be as the above guidelines suggest. This is acceptable if the drill chosen is the one to suit the needs of the job, provided non standard tube or solid drills are available.

3. Use a wax to fix the substrate firmly onto a glass base, with the datum edges of the substrate overhanging slightly and parallel to the edges of this base, when necessary for accurate alignment.
4. Fix the glass plate to the X-Y table (with the edges parallel to the travel of the table, and the datum at a known point, when necessary) and then position the table to allow drilling of the substrate in the required position.
5. Apply coolant to the area to be drilled, either via a wash bottle or through the waterfeed system on the meddings drill.
6. Drill by applying light pressure over short periods to allow adequate flow of coolant over the position being drilled.
7. After drilling, separate the substrate and the glass by melting the wax, and clean the substrate in a suitable solvent.

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Approv. by	[Signature]									
Eng. Dept.										
Approv. C.I.	[Signature]									

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TITLE DRILLING AND SAWING OF QUARTZ AND ALUMINA SUBSTRATES
FOR SAW APPLICATIONS
DRILLING (ALUMINA ONLY)

B. To Remove Large Areas from the Substrate (Alumina Only)

1. As A No. 1
2. Use a wax to fix the substrate firmly to a glass base.
3. Use an old bit and move the substrate while drilling so that a continuous hole is drilled all round the edge of the area to be removed.
4. As A No. 7
5. Use a diamond file to smooth the drilled edges
6. Clean with acetone.

C. For Square and All Other Holes (Alumina Only)

1. As B No. 2
2. As A No. 1
3. Fix the glass plate to the X-Y table and then position the table to allow drilling of the substrate in the required position.
4. Use the ultrasonic drill and a slurry of carborundum to drill the hole.
5. As A No. 7

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Prep. by	W.E. HARRIS									
Approv. by	H.H.C.									
Eng. Dept.										
Approv. C.I.	P. K. ...									

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GEC RESEARCH LABORATORIES
HIRST RESEARCH CENTRE
WEMBLEY MIDDX

F S McCLEMONT
22 JUNE 1983

TECHNICAL NOTE

BS9450 CAPABILITY - CALIBRATION OF HEWLETT PACKARD 8507B
NETWORK ANALYSER SYSTEM

There has recently been some uncertainty associated with the calibration procedure for the Piezoelectric Departments HP 8507B network analyser. Calibration is essential for maintenance of BS9450 capability for SAW devices and other (Def Stan 0521) contracts. The current procedure is as follows; a number of coaxial reflection and transmission standards are measured annually by EQD (Aquila) at appropriate frequencies. The calibrated standards are then re-measured using the Piezoelectric Departments HP 8507B and the results recorded. This is all relatively straight forward. The uncertainty arises in deciding what criteria determine whether the instrument is within calibration. In an effort to clarify this point I have spoken by telephone with Mr Barry Colville of Aquila, who is responsible for the calibration of Aquila's own HP 8507B. A summary of the discussion is given as follows:-

- i. the Aquila analyser is also calibrated using a set of traceable standards.
- ii. measurements from the analyser are recorded weekly, allowing a statistical model of the variations and discrepancies to be established.
- iii. EQD rely on automatic measurements employing error correction software.

The following recommendations were made:-

- i. HRC should measure standard more frequently, eg. weekly or monthly.
- ii. The method of measurement (ie. manual or automatic) should reflect the normal method of use of the instrument. In our case, this is usually a manual only method, although some error corrected measurements could be made for, for example, small return losses.
- iii. Whether the instrument is within calibration for a certain measurement or not could be decided by imposing sensible maximum allowed deviations of the HRC measurements from a true (EQD) measurements of the standards, these being determined by reference to what is actually called up by customers/specifications for the devices in question.

F S McCLEMONT
22 JUNE 1983
SHEET 2

It was agreed that it would be very difficult to decide calibration in terms of the published performance specification of the instrument, since this is only given for each section of the system individually.

In view of the above comments I suggest the following criteria are employed as a provisional starting point:

1. (Measurements at 10, 30, 100 500, 1000 MHz)
50 Ohm Termination
VSWR to be within ± 0.01 of the EQD value on both parts.
Reference - open circuit APC7.
2. 2dB, and 6dB Reflection Standards
Return Loss to be within ± 0.1 dB of the EQD value on both parts, using AIM if necessary.
Reference - open circuit APC7 for manual measurement.
3. 12dB Reflection Standard
As (2) but tolerance = ± 0.2 dB.
4. 1dB, 3dB, 6dB, and 10dB Alternators
Alternation to be within ± 0.1 dB of the EQD value for S_{12} and S_{21} , referenced to 2 off APC7 cables.
Reference - HP 8120-2291.
5. 20, 30, 50dB Alternators
As (4) but tolerance = ± 0.2 dB
6. 80dB Alternator
As (4) but tolerance = ± 0.5 dB.
7. 30cm Airline
To be determined *Electrical length within 1cm
of EQD value @ 30/100 MHz
Within 0.1cm @ 500/1000 MHz.*

FREQUENCY CALIBRATION

A procedure for the frequency calibration of the 8507B has not yet evolved. The requirement is to ensure that the market gives valid readings, since this is the normal method of device frequency measurement. The Piezoelectric Department has a frequency standard (rubidium) traceable to a Primary (Droitwich). There appears to be no convenient method of using this to calibrate the market directly. However, a method has been proposed by which passive frequency standards, eg. quartz crystal or SAW resonators with moderately high Q values. The resonant frequencies of these components could be measured on the Resonator Parameter Measurements System, which has frequency sources traceable to the off - air standard, and then re-measured on the 8507B using the frequency marker. A comparison would determine whether the figures obtained were within a sensibly prescribed tolerance band.

F S McCLEMONT
22 JUNE 1983
SHEET 3

CIRCULATION:

Mr A J Dyer
Dr E Read
Mr A J Byrne

Mr J B Patrick
Mr D T Lewis
Mr G Barradell
Mr J Parker

HIRST RESEARCH CENTRE

S.A.W.s

Maintenance of NS 9450 Capability Approval

Discussion Held on Monday 23 May 1983

D T Lewis

25 May 1983

Present: Mr F S McClemont
Mr A L Haston
Mr D T Lewis

Introduction

The original BS9450 Capability Approval for the production of SAW devices was granted on the 11th November 1981, consequently to comply with the requirements of BS9450, a programme of work should have been completed 12 months later to maintain the approval. However this maintenance exercise has not occurred, and EQD have intimated that the approval certificate will be withdrawn if a maintenance undertaking is not completed by the beginning of November.

In an endeavour to retain our BS 9450 Capability Approval Status for SAW devices, D T Lewis has been requested to organise and supervise an exercise, and will liaise with Dr Tim Reynoldson of EQD and Mr A Dyer of HRC.

To assess the present situation, and make an early start, a discussion has taken place and some of the main topics are now reported.

1 Original qualification

The CQCs which were produced to obtain the original Capability Approval were the 63.5 MHz Mc Michael filter on quartz, and the 60 MHz DPSK on lithium niobate - LiNbO_3 . These two devices are no longer being produced at HRC, consequently the capability maintenance exercise will be conducted with a 200 MHz quartz narrow band filter (CQC-SAW 4) and a 120 MHz lithium niobate wide-band filter (CQC-SAW 5)

2 Test samples

A number of devices of each of the two categories will be constructed and three samples of each type will be selected and fully tested for the purpose of Capability Approval.

3 Material and components

None of the components or material for the production of the quartz devices is available at HRC. However production of these filters is about to commence at MEDL, Lincoln, and components will be available from that source.

All components for the LiNbO_3 filter are stocked in HRC bonded store.

4 Test equipment

The equipment which will be used to test the electrical parameters of the filters will be a Hewlett Packard automatic analyser - Type 8507B. It is checked periodically against standard attenuators which, in turn, are calibrated at EQD, Aquila, Bromley. The present calibration period expires in July 1983, hence re-calibration must be carried out in the near future. G Barradell - who is responsible for the standard attenuators, has been informed. The calibration frequencies are at 30 MHz, 100 MHz and 500 MHz.

5 Device sealing

The quartz device-saw 4 - is hermetically sealed by 'seam' sealing. This operation is performed at MSDS Portsmouth.

The lithium-niobate filter is sealed by resistance welding which is conducted at MEDL - Lincoln.

6 Process manual and drawings

Only limited data manuals and drawings exist at HRC; MEDL-Lincoln will be approached to try and obtain copies for HRC of production instructions for SAW-4. The build standard for CQC-2 will be used as a basis for SAW-5.

7 General comments

SAW-4 packages and lids are obtainable from Misco Ltd. Quartz substrates are obtainable from ITT Harlow. Alumina substrates with 'thick film' circuits are available from MEDL. Chip inductors and trimmer capacitors are usually stocked at MEDL Lincoln, but may also be purchased from Stanwyck Inc. U.S.A.

SAW-5 packages are purchased from Misco Ltd. Lithium-niobate bases are purchased as 'SAW' grade, from Messrs. Barr and Stroud, who are working in conjunction with RSRE to generate a more definitive specification.

The substrates are tested and qualified at HRC at present.

8 Masks

A mask for SAW-5 is available, but a mask for SAW-4 will have to be borrowed from MEDL or generated at HRC. This would be an urgent priority, but even so, is not likely to be available before mid-June.

9 Test specifications

Permission will be sought if necessary to use the MSDS specification for the narrow-band, SAW-4 device, and from Stanmore to use the 120 MHz-SAW-5 filter.

10 Time scale

Figure 1 shows an estimation of the time required to complete the major parts of the exercise provided no unforeseen delays are encountered. These time forecasts will be constantly reviewed and delays reported.

11 Summary

Required:

- 1 Process instructions
- 2 Materials and components from MEDL
- 3 Confirm, check and qualify components and parts for the LiNbO_3 device.
- 4 Obtain test specifications
- 5 Check qualification of test equipment
- 6 Generate PERT diagram
- 7 Obtain drawings from Lincoln
- 8 Discuss minor details with Dr Tim Reynoldson

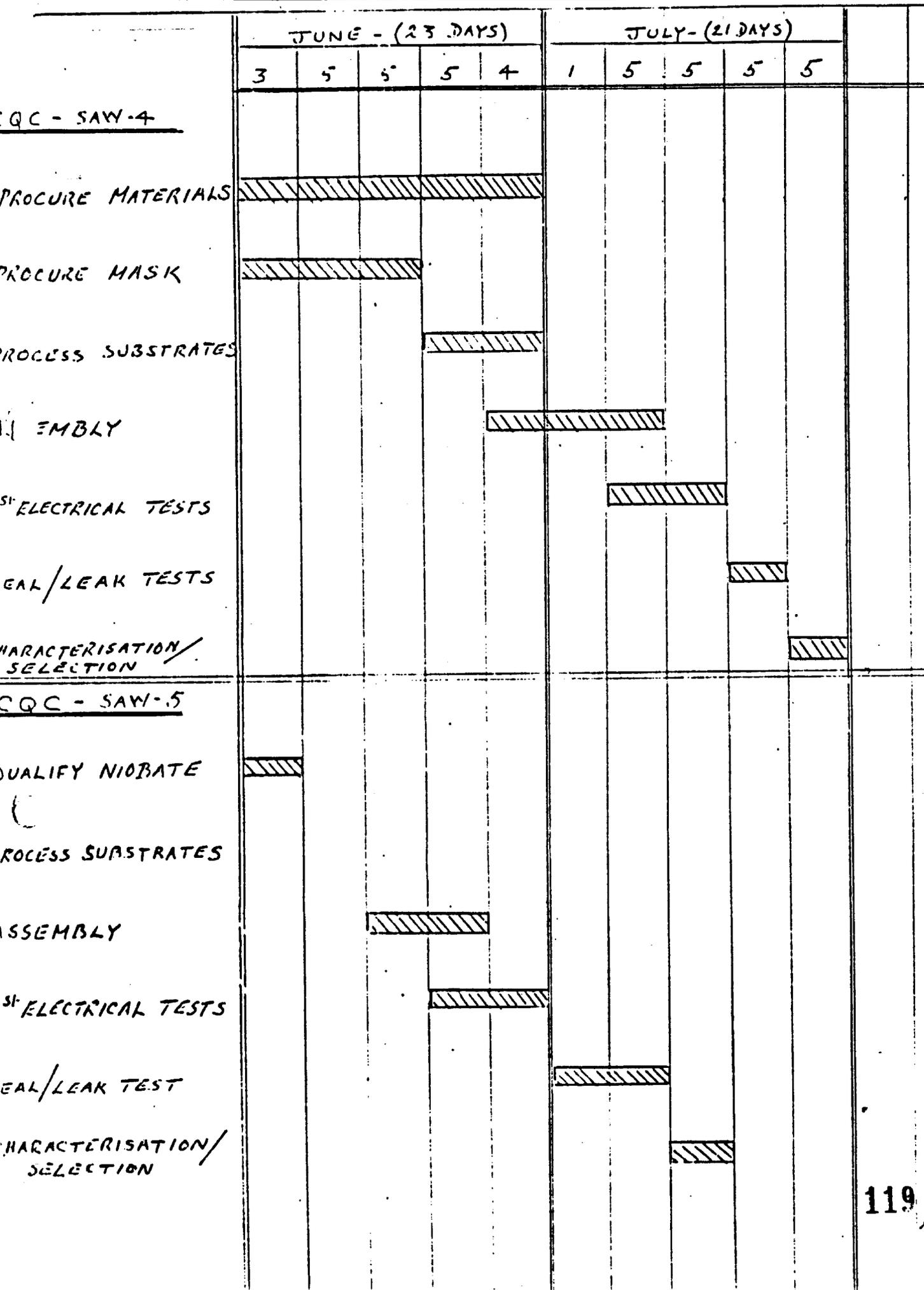
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Mr A L Haston
Mr N H Doggett
Mr J B Patrick
Mr J H Holliday
Mr D T Lewis
Dr D V McCaughan

Mr T H Oxley MEDL Lincoln
Mr J Anderson "
Mr S Neylon "

1. FABRICATION OF CQC - SAW-4 AND SAW-5

PROVISIONAL BAR CHART - SAMPLE PRODUCTION



GEC RESEARCH LABORATORIES

HIRST RESEARCH CENTRE

WEMBLEY

18 May 1983

TO: MR A J DYER

Copies to:

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Dr E Read

Mr D E Hooper

Mr A L Haston

Mr F S McClemon

Mr A J Dyer

Mr J H Holliday

✓ Mr D T Lewis

Mr T H Oxley MEDL, Lincoln

Mr S I Neylon MEDL, Lincoln

Mr J Anderson MEDL, Lincoln

Ref BS9450 Capability Maintenance - SAW Devices

Thank you for your note of the 17th May. Now we have at last established a funding method, it is important to get the work started and completed as soon as possible. I have asked Dewi Lewis to liaise with you on this work and I expect he has already started. Presumably we shall cover the lithium niobate substrate capability as well as the quartz substrate for the £10K. I note your last paragraph and in these unusual circumstances I think we can fund the QA costs ourselves.

I shall now write to Dr Reynoldson assuring him that we are putting the work in hand.

J B PATRICK

JBP/IS

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		DATE		No SHEET 1 OF 4	
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				DRAWN TO B.S. 308	

1. Description

This drawing defines the characteristics and test requirements of a quartz substrate for Surface Acoustic Wave applications. Dimensions and tolerances shall be as shown on Sheet 3.

2. Materials

- 2.1. The material shall be single-crystal α -quartz, showing no evidence of twinning or other lattice defects, nor shall it include any part of the seed crystal or interface region.
- 2.2. The orientation, which may be determined by the use of x-ray diffraction techniques, will be as shown on Sheet 3. Each long edge shall be parallel with the X axis to $\pm 0.1^\circ$.

3. Surface Finish

3.1. The substrate shall be polished on one major face, using the 'SYTON' or similar machano-chemical process. Other faces shall show a fine ground finish (Unless otherwise specified)

3.2. Scratches

The polished surface shall show no scratches visible under a microscope at x50 magnification. Scratches may be permitted within 1mm of the edges.

3.3. Pits and Dimples

The polished surface shall exhibit no pits nor dimples of lateral dimension greater than 1 μ m except within 1mm of any edge.

UNLESS OTHERWISE STATED THE FOLLOWING TOL'S APPLY TO ALL DIM'S	ABOVE 1000	± 1.5	QTY	PT	DESCRIPTION	DRG NO / MATL	
			ISSUED BY		MIC. DEV.	D.O.	<p>MARCONI ELECTRONIC DEVICES LIMITED</p> <p>LINCOLN ENGLAND</p>
			DRAWN		RJ1 / SW	12/4/83	
	CHECKED		[Signature]	12/4/83			
	ISSUE TO						
	3000 TO 999.9	± 1.0	DC	1		TITLE	POLISHED QUARTZ SUBSTRATE
			MICRO. DEV.	1			
			J.T. B.P.	1			
			ISSUE TO				
	UP TO 299.9	± 0.4				DEVICE	121
8 1/4" x 11 1/4" A4		THIRD ANGLE PROJECTION		SCALE	PLANT NO	DRG. E16929/A4 No SHEET 1 OF 4	

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DRG. E16929/A4
 NO SHEET 2 OF 4
 ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED
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REVISIONS

3.4. Occlusions

No solid or fluid occlusions shall be observable under 50x magnification that either break the polished surface or occur within 0.25mm of it.

3.5. Cracks

There shall be no visible cracks when viewed in strong incandescent light.

3.6. Flatness

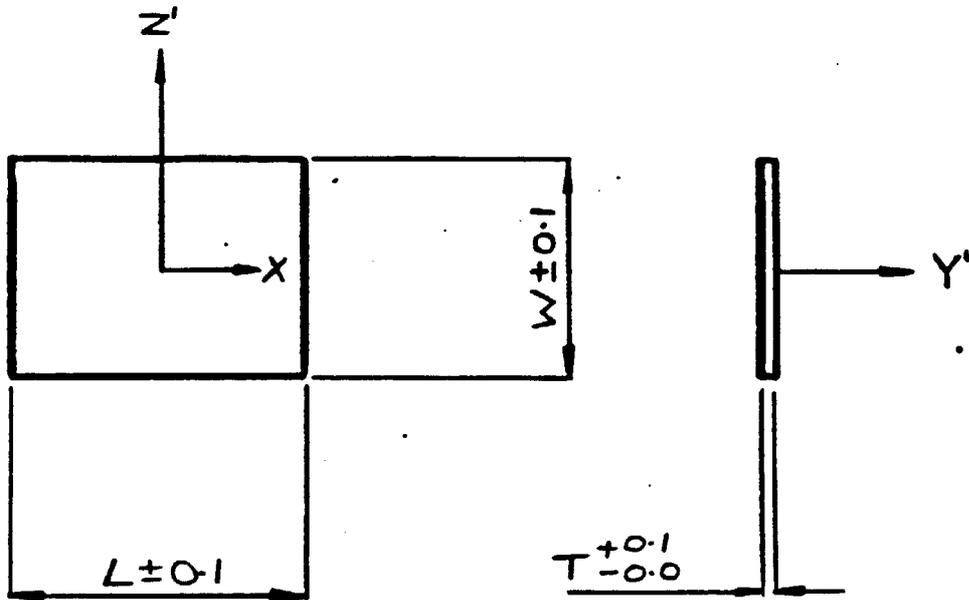
The polished surface of the substrate shall be checked for flatness with the substrate supported on its ground surface at the Airey points, that is supports approximately 22mm apart for 40mm substrates and 17mm apart for 30mm substrates. The surface shall lie between two planes 10µm apart except that an overall bow of 30µm along the length of the substrate is allowed. These criteria shall not apply within 2mm of any edge.

4. Identity

The polished substrate shall be known by it's MEDL identity with the appropriate part number.

UNLESS OTHERWISE STATED THE FOLLOWING TOL'S APPLY TO ALL DIM'S	ABOVE 1000 ± 1.5	QTY	PT	DESCRIPTION	DRG NO / MATL	
		ISSUED BY MIC DEL D.O.		MARCONI ELECTRONIC DEVICES LIMITED LINCOLN ENGLAND POLISHED QUARTZ SUBSTRATE DEVICE 122		
		DRAWN	REB/SW			12/1/83
	CHECKED	[Signature]	12/1/83			
	300.0 TO 999.9 ± 1.0	ISSUE TO		TITLE		
		CO	1	POLISHED QUARTZ SUBSTRATE		
		MIC DEL	1			
	UP TO 299.9 ± 0.4	8 1/4" x 11 1/4" A4		THIRD ANGLE PROJECTION	SCALE	PLANT NO
						DRG. E16929/A4 NO SHEET 2 OF 4

REVISIONS	REV.	APP'D.	UNCONTROLLED COPY	DRG. E16929/A4 No SHEET 3 OF 4
	DATE			
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SEE TABLES ON SHEET 4

UNLESS OTHERWISE STATED THE FOLLOWING TOL'S APPLY TO ALL DIM'S	ABOVE 1000	± 1.5	QTY	PT	DESCRIPTION	DRG NO / MATL	
	300.0 TO 999.9	± 1.0	ISSUED BY		MIC DIV. D.O.	MARCONI ELECTRONIC DEVICES LIMITED LINCOLN ENGLAND	
			DRAWN		RJI 11-4-83		
			CHECKED		HLA 12-4-83		
			ISSUE TO				
	UP TO 299.9	± 0.4	CO	1		POLISHED QUARTZ SUBSTRATE	
			M.C.D.V.D.O.	1			
			J.T.O.L.I.N	1			
			INSF.	1		DEVICE	123
			8 1/4" x 11 1/4" A4	THIRD ANGLE PROJECTION		SCALE N.T.S.	PLANT NO

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REV. APP'D BY DATE
 1 DATE 27-4-83
 Q OF QUARTZ WAS TYPE N9
 FOR PART -7, VALUES L, W & CUT REFADED

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DRG. E16929/A4
 NO SHEET 4 OF 4
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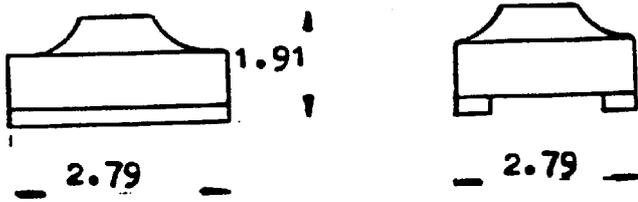
CUT REF.	QUARTZ MATERIAL	ANGLE OF ROTATION OF Y' AXIS FROM Y AXIS
50	NATURAL	+42°45' ±0.1°
51	NATURAL	+39°00' ±0.1°
52	NATURAL	+35°25' ±0.1°
53	SYNTHETIC	+42°45' ±0.1°
54	SYNTHETIC	+39°00' ±0.1°
55	SYNTHETIC	+35°25' ±0.1°
56	SYNTHETIC	+40°00' ±0.1°

QUARTZ PLATE DIMENSIONS (mm)

PART NO	Q OF QUARTZ	L	W	T	CUT REF	DRG. NO	MAN PART NO
-/1		31.5	6.0	0.5	53	15368/A3-1	S214
-/2		25.0	20.0	0.5	53	15368/A3-2	S215
-/3		54.0	12.5	2.0	53	15245/A3	S180
-/4		57.0	7.0	2.0	53	15246/A3	S185
-/5	r	54.0	12.5	2.0	53	15245/A3	S180
-/6	i	57.0	7.0	2.0	53	15246/A3	S185
-/7	22x10° NOMINAL	28.0	22.0	0.5	51		

UNLESS OTHERWISE STATED THE FOLLOWING TOL'S APPLY TO ALL DIM'S	ABOVE 1000 ±1.5	QTY	PT	DESCRIPTION	DRG NO / MATL	
	3000 TO 999.9 ±1.0	ISSUED BY		MIC. DIV.	D.O.	MARCONI ELECTRONIC DEVICES LIMITED LINCOLN ENGLAND
		DRAWN		RJI	11-4-83	
		CHECKED		<i>[Signature]</i>	12/4/83	
	ISSUE TO					
	DO		1			
	UP TO 299.9 ±0.4	MIC DIV'S		1		
		J TOBIN		1		
		INSP		1		
	8 1/4" x 11 3/4" A4		THIRD ANGLE PROJECTION		SCALE	PLANT NO
				DRG. E16929/A4 NO	SHEET 4 OF 4	
				DEVICE	124	

REVISED	APPD. <u>W</u> <u>30</u>	T. WORK. <u>30</u>	DRG. NO. <u>15622/A4</u>
	DATE <u>27/2/82</u>	<u>25-5-82</u>	Sheet <u>1</u>
NOTE ADDED TO CURRENT RATING		DIMENSIONS NOT TO BE INSPECTED ADDED	ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED
			© 19 81 AEI SEMICONDUCTORS



DIMENSIONS
NOT TO BE INSPECTED

- Operating Temperature : -55°C to 125°C
- Current Rating @ : 90°C amb. (as specified on relevant data sheet)
- Weight Maximum : 0.03 grams
- Maximum Power Dissipation @ : 90°C = 175mW
- Insulation Resistance : 1000MΩ min @ 100V DC
- Dielectric Withstanding Voltage : sea level 200Vrms
70K ft 80Vrms
- Load Life @ : 90°C - 2000hrs @ rated current
- Mechanical Configuration : 1) Epoxy Overcoat
2) Solder pads are gold plated per MIFG45204 type 1 grade A
- Tolerance : M = 20%
K = 10%

Resistance at 200MHz less than 20 ohms.

UNLESS OTHERWISE STATED THE FOLLOWING TOL'S APPLY TO ALL DRG'S	ABOVE 1000 ± 1.5	QTY	PT	DESCRIPTION	DRG NO / MATL	
	3000 TO 999-9 ± 1.0	ISSUED BY SEMICONDUCTOR D.O.				AEI SEMICONDUCTORS LTD LINCOLN ENGLAND
		DRAWN	<i>[Signature]</i>	24/1/82		
		CHECKED	<i>[Signature]</i>	30/3/83		
ISSUE TO				TITLE		
UP TO 299-9 ± 0.4	DO	1			CHIP INDUCTORS	
	INSP	1				
	Stock	1				
	T. WORK	1				
					DEVICE	
					15622/A4	
					125	
	8 1/2" x 11 1/2" A4	THIRD ANGLE PROJECTION		SCALE	PLANT NO	
					DRG. NO. 15622/A4 Sheet 1	

REVISIONS	REV	APPR	DRG. No. 15622/A4 Sheet 2
	DATE		
			ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED
		© 19 83 AEI SEMICONDUCTORS	

Pt. No.	Value (uH)	Manufacturer and Serial No.
1	0.15	Stanwick Inc.

Supplier: Inductor Supply Inc.
15206 Transistor Lane
Huntingdon Beach
California 92649
U.S.A.

UNLESS OTHERWISE STATED THE FOLLOWING TOL'S APPLY TO ALL DIM'S	ABOVE 1000 ± 1.5	QTY	PT	DESCRIPTION	DRG NO / MATL	
		ISSUED BY		D.O.	AEI SEMICONDUCTORS LTD LINCOLN ENGLAND	
	DRAWN	<i>[Signature]</i>	29-3-82			
	CHECKED	<i>[Signature]</i>	30/3/82			
	3000 TO 999-9 ± 1.0	ISSUE TO			TITLE	CHIP INDUCTORS
	UP TO 299-9 ± 0.4				DEVICE	126
		8 1/2" x 11 1/4" A4			THIRD ANGLE PROJECTION	SCALE
					DRG. No. 15622/A4 Sheet 2	

REV.	APPD.
	DATE

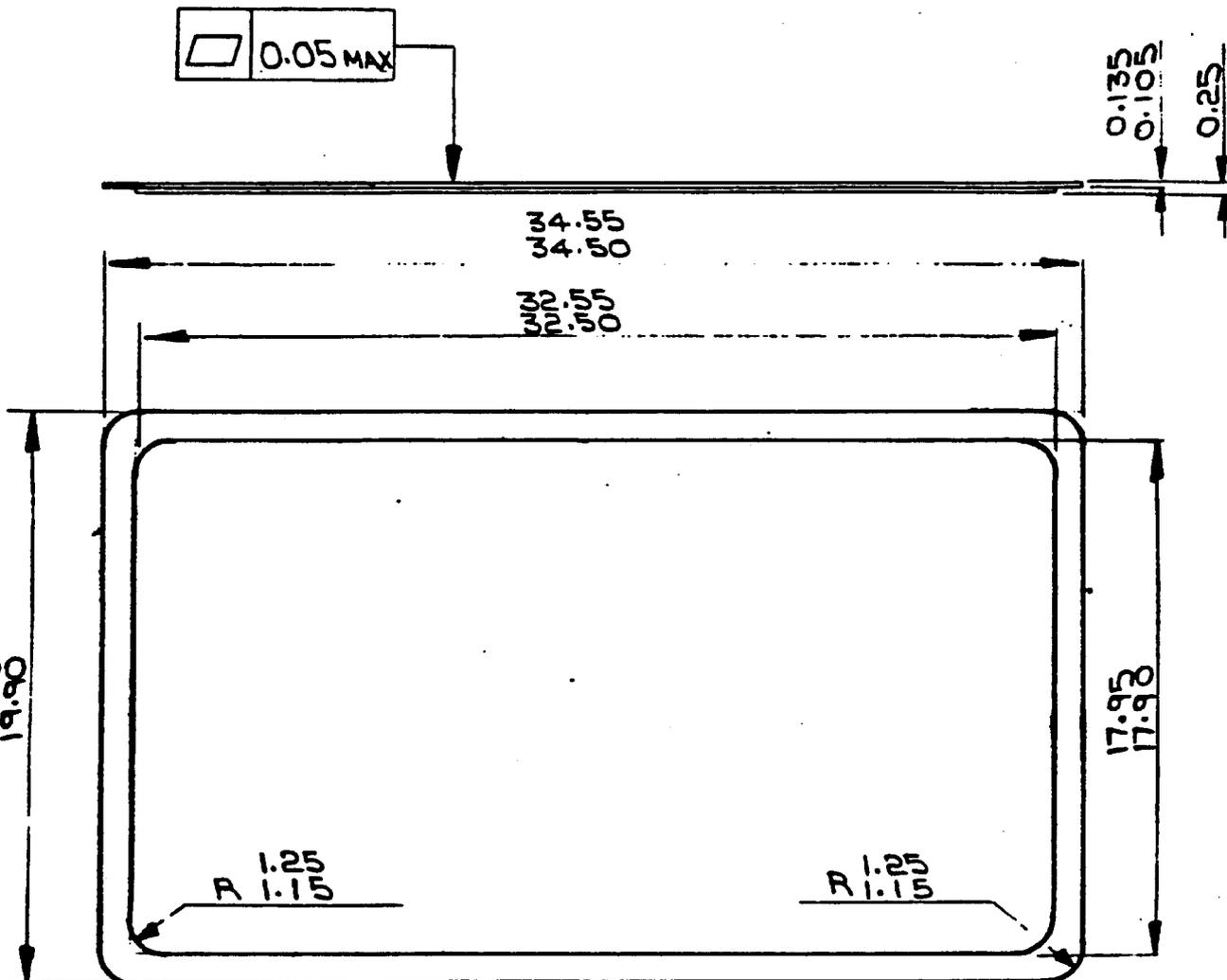
DRG. No **15367/A4**

ALL DIMENSIONS IN MILLIMETRES
UNLESS OTHERWISE STATED

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DRAWN TO B.S. 308

REVISED



MATL:

KOVAR

FINISH

NICKEL

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	3000 TO 999.9 ± 1.0	ISSUED BY M.E.O.L.		D.O.	MARCONI ELECTRONIC DEVICES LIMITED LINCOLN - PREVIOUS DATE. ENGLAND
	UP TO 299.9 ± 0.4	DRAWN <i>[Signature]</i>		10-8-82	
		CHECKED <i>[Signature]</i>		22/1/82	
		ISSUE TO			
					STEPPED LID FOR S.A.W. NB4 PACKAGE
				DEVICE	DA 9200 127
	8 1/2" x 11 1/4" A4	THIRD ANGLE PROJECTION		SCALE 4/1	PLANT No DRG. No 15367/A4

REVISIONS	REV. APP'D. AM 30	3	09 73	DRG. Sheet 2 No K2699919 of 2
	1 DATE 2-7-82		30-9-82	
	PART 18 ADDED	PART 20 ADDED		ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED
	2 11/5/82 30 12/5/82 6-5-82			
	PART 19 ADDED		© 1979 AEI SEMICONDUCTORS	

- PT. 17 JUNCTION COATING RESIN TYPE DC643 IN 1 PINT CONTAINERS. SUPPLIER DOW CORNING.(SEE NOTE SHEET 1)
- PT. 18 Silastic 731 RTV Adhesive/Sealant in 3oz/85gms. tubes Store below 90°F. Supplier Dow Corning.
- Pt. 19 Silastic 738 RTV Adhesive/Sealant Store below 90°F. Supplier DTV Group Ltd.,
- Pt. 20 Dow Corning Gel Q3-6527 A & B

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	300-0 TO 999.9 ± 1.0	ISSUED BY SEMICONDUCTOR D.O.				AEI SEMICONDUCTORS LTD LINCOLN ENGLAND
		DRAWN	<i>[Signature]</i>	11-7-79		
	CHECKED	<i>KJ Sefton</i>				
	UP TO 299.9 ± 0.4	ISSUE TO				PURCHASE SPEC. RUBBER COMPOUNDS
		DO	1	M.P.M.C	1	
		INSP	1	H. POWER	1	
		STOCK	1	A. NESANAN	3	
		COMP.	2			
		J.P.N	1			DEVICE 128
	A. GRAY	1				
	8 1/2" x 11 1/4" A4	THIRD ANGLE PROJECTION		SCALE /	PLANT NR	
				DRG. K2699919 NR Sheet 2 of 2		

REVISIONS	V. APPD.	30	7/10	30	20	18-82	DRG. K2699909
	DATE	7-11-80	19	25-8-81	24-8-81		Nº Sheet 1 of 3
	RE-DRAWN.		SHEET 3 ADDED PT 27		PART 6 WAS SUPERSEDED LIQUID FLUX		ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED
							© 19 80 AEI SEMICONDUCTORS

Pt. No.	Composition	Grade	Size	Supplier
1	1% ± 25% Tin/Lead	99.99% Purity	16SWG	
2	65% Tin 35% Lead	'A'	8oz Rods	
3	60% Tin 3% Silver	Superspeed Resin Cored Activated	21SWG 11b.Reel	Enthoven
4	60% Tin 40% Lead	Resin Cored Flux 362 to DTD 599	18SWG	
5	39% Tin 59% Lead 2% Antimony	'C' Solid Solder	16SWG 71b.Reels	
6	Resin Flux RL3/50		1 Pint	Enthoven
7	Easy Flow No. 2	Brazing Wire .010" dia	11b.Reels	J.M. Co.
8	Ersin Multicore Five Core Solder	LMP Silver Alloy Flux 362 To DTD 599	24SWG 1/2lb.Reels	Multicore Solders Ltd
9	60% Tin 40% Lead	Resin Cored Arax Flux	18SWG 11b.Reels	Multicore
10	See K2699909 A&B	Savbit Type 1		
11	See K2699909C	Pure Tin 99.9%		
12	See K2699909D	65/35% Tin Lead Alloy		
13	99.75% Pure Tin	3 Cores 'N' Flux DTD 599A	18SWG 71b.Reels	Multicore

UNLESS OTHERWISE STATED THE FOLLOWING TOL'S APPLY TO ALL DIM'S	ABOVE 1000 ± 1.5	QTY	PT	DESCRIPTION	DRG Nº / MATL	
	3000 TO 999.9 ± 1.0	ISSUED BY SEMICONDUCTOR D.O.				AEI SEMICONDUCTORS LTD LINCOLN ENGLAND
		DRAWN	<i>W. Sweeney</i>	7-11-80		
		CHECKED	<i>P.A. Turner</i>	12-11-80		
	UP TO 299.9 ± 0.4	ISSUE TO				TITLE SOLDER, FLUX, BRAZE WIRE
		DO	1	A. W. S. A. P. H.	3	
		INSP	1			
		STOCK	1			
		COMP	2			
	PLR	1			DEVICE	129
M.G.S	1			SCALE	PLANT Nº	
8 1/2" x 11 1/2" A4	THIRD ANGLE PROJECTION			DRG. K2699909	Nº Sheet 1 of 3	

REVISIONS	V. APPD.	30	DRG. No K2627256 Sheet 2
	DATE	21-12-82	
	PAKT II A0060		© 19 82 MEDL
			DRAWN TO B.S. 308

- Pt. 10 Gold Wire. 99.99% Pure Diameter 0.001ins. \pm 0.00001in. Elongation 2 to 4%. Fully annealed on TS1 lightweight spool. Single layer 20 metres long. Free end to be clearly indicated.
- Pt. 11 Gold Wire 99.99% Pure diameter 0.0015ins. \pm 0.0002ins. Elongation 10-15%. Appearance Continuous, Clean with no kinks and no loose turns.

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	300.0 TO 999.9 \pm 1.0	ISSUED BY M.E.O.L		D.O.	MARCONI ELECTRONIC DEVICES LIMITED LINCOLN ENGLAND
		DRAWN	<i>W. J. ...</i>	6-8-82	
		CHECKED	<i>...</i>		
	UP TO 299.9 \pm 0.4	ISSUE TO			TITLE
					Purchasing specifications Pure gold wire
				DEVICE	
8 1/2" x 11 1/4" A4	THIRD ANGLE PROJECTION		SCALE	PLANT NO	DRG. No K2627256 Sheet 2
					130

REVISIONS	REV.	APPR.	DRG. NO	15388/A4	
	DATE				
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			DRAWN TO B.S. 308		

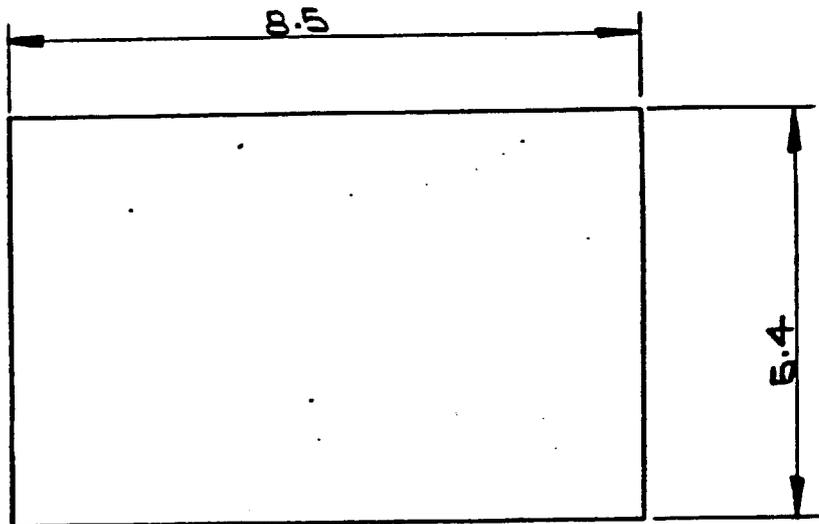
S.A.W. Masks Based on N200-5 Design, Design information controlled by Hirst Research Centre, Wembley, Middx.

Pt. 1 3 x 1 array

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	300.0 TO 999.9	± 1.0	ISSUED BY	M.E.O.C	D.O.	MARCONI ELECTRONIC DEVICES LIMITED LINCOLN ENGLAND		
			DRAWN	<i>[Signature]</i>	27/5/82			
			CHECKED	<i>[Signature]</i>	1/6/82			
	ISSUE TO			TITLE	S.A.W. MASKS			
	UP TO 299.9	± 0.4			DEVICE		DA 9200	131
					SCALE	PLANT NO	DRG. NO	15388/A4
					8 1/4" x 11 1/4" A4	THIRD ANGLE PROJECTION		

REVISIONS	REV.	APP'R.	DRG. No. 15375/A4	
	DATE			ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED
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			DRAWN TO B.S. 308	



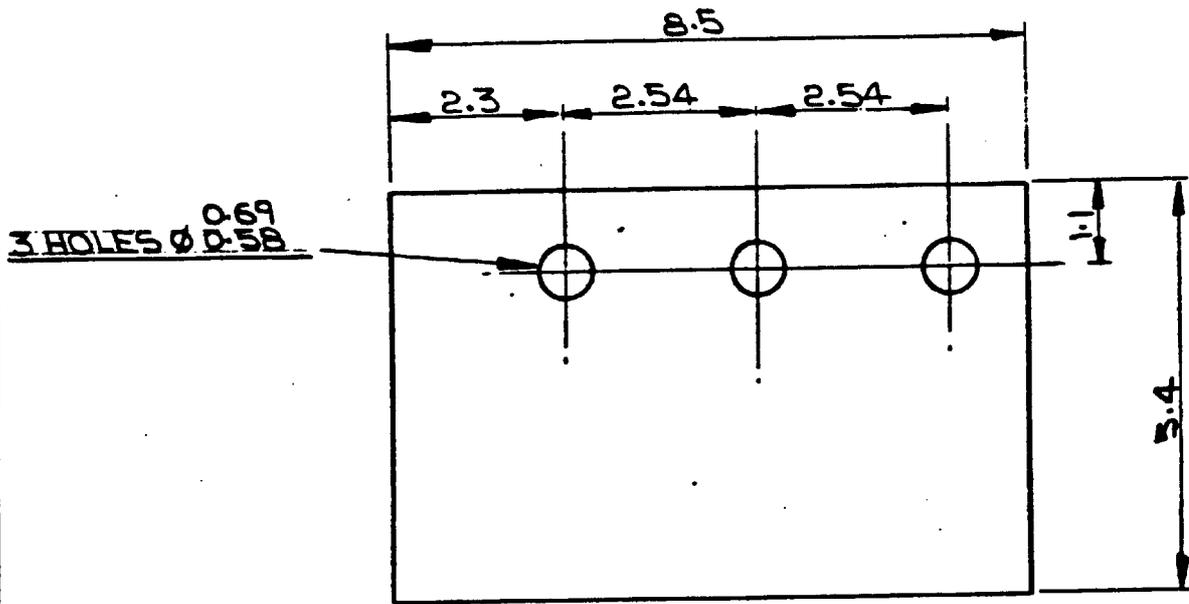
MATL:

DERANOX 995, 96% ALUMINA 0.508 ± 0.013 THICK

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	300.0 TO 999.9 ± 1.0	ISSUED BY M. E. O. L.		D.O.	MARCONI ELECTRONIC DEVICES LIMITED		
		DRAWN	<i>M. E. O. L.</i>	10.5.82	LINCOLN ENGLAND		
	UP TO 299.9 ± 0.4	CHECKED	<i>[Signature]</i>	12/5/82	TITLE		
		ISSUE TO			SUBSTRATE BLANK FOR THICK FILM CIRCUIT		
					DEVICE	DA9201 DA9200 132	
	8 1/4" x 11 3/4" A4		THIRD ANGLE PROJECTION		SCALE	PLANT NO	DRG. No. 15375/A4

REVISIONS	REV.	APPD.	DRG. No. 15370/A4	
	DATE			ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED
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			DRAWN TO B.S. 308	



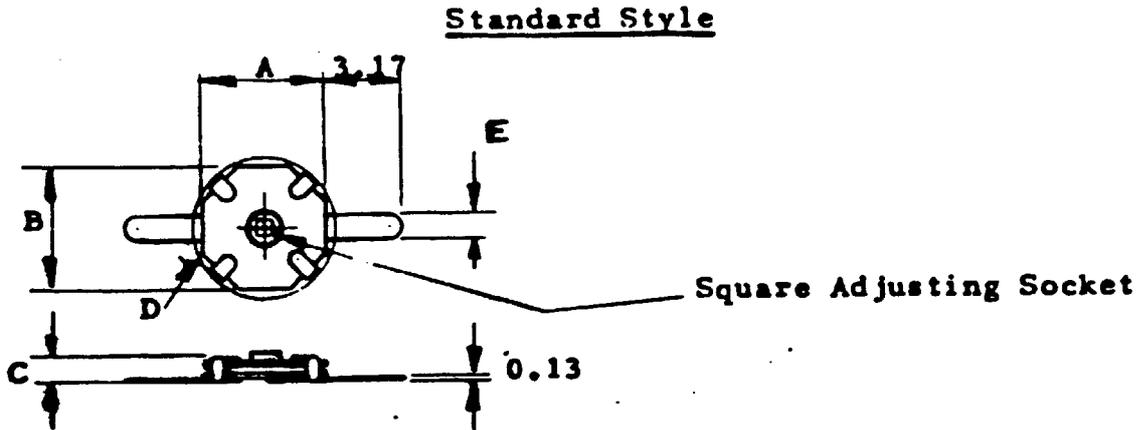
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ISSUED BY M.E.D.L.

DATE: 12/1/82

UNLESS OTHERWISE STATED THE FOLLOWING TOL'S APPLY TO ALL DIM'S	ABOVE 1000	± 1.5	QTY	PT	DESCRIPTION	DRG NO / MATL
	3000 TO 999.9	± 1.0	ISSUED BY M.E.D.L. D.O.		MARCONI ELECTRONIC DEVICES LIMITED ENGLAND	
	UP TO 299.9	± 0.4	DRAWN	4-5-82	LINCOLN	
			CHECKED	12/1/82	ENGLAND	
			ISSUE TO		TITLE	
					DRILLING DIAGRAM FOR THICK FILM CIRCUIT.	
					DEVICE	DA 9201 DA9200 133
			8 1/4" x 11 1/4" A4		SCALE	PLANT NO DRG. No. 15370/A4
			THIRD ANGLE PROJECTION			

REVISIONS	REV.	APPR.	DRG. 15373/A4 No Sheet 1
	DATE		
			ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED
			© 19 82 MEDL DRAWN TO B.S. 308



SPECIFICATIONS

Dielectric withstanding voltage	Rating 250VDC Test 500VDC
Operating Temper Range	- 20° to 85°C
Insulation Resistance	> 10 ⁴ Megohms
Vibration	15g's @ 10 - 2000Hz
Shock	100 g's @ 6ms
Capitance Drift	< 1%

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UNLESS OTHERWISE STATED THE FOLLOWING TOL'S APPLY TO ALL DIM'S	ABOVE 1000	± 1.5	QTY	PT	DESCRIPTION	DRG NO / MATL
	300-0 TO 999.9	± 1.0	ISSUED BY M.E.D.L. D.O.		MARCONI ELECTRONIC DEVICES LIMITED LINCOLN ENGLAND	
	UP TO 299.9	± 0.4	DRAWN	6-6-82		
			CHECKED	7/6/82	TITLE Thin Trim Ceramic Capacitors	
			ISSUE TO		DEVICE	134
			8 1/4" x 11 1/4" A4	THIRD ANGLE PROJECTION	SCALE	PLANT NO
					DRG. NO	15373/A4 Sheet 1

7. Inspection Requirements

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ISSUE DATE
 A 27-2-81
 3 12-6-81
 C 30-6-81
 D 24-9-81
 E 15-3-82
 F 3-1-82

INSPECTION OR TEST	BS9450 Reference and Conditions of test	Requirements		
		Limits		Units
		Min	Max	
GROUP A				
Subgroup A1 Visual Inspection	Inspection level I 1.5% AQL 1.2.2			
Subgroup A2	Inspection level 100% $T_{amb} = 25^{\circ}C$			
Reference Frequency VSWR's			6.0	
Insertion Loss	Conditions and limits as para. 2 unless otherwise stated:- as sheet 05 attached (gain adjusted)			as Sht. 05
Amplitude Response			2	dB(pk-pk)
Amplitude Tracking			12°	deg(pk-pk)
Phase Tracking			2.75	us.
Group Delay			3.25	us.
GROUP B				
Subgroup B1	Inspection level S2 AQL 5.5% 1.2.3			To sheet Number 01 10.75 grams
i) Dimensions * ii) Weight *				
Subgroup B2 Soldersability *	Inspection level S4 AQL 4% 1.2.6.15.1 on at least two leads on any one specimen			
E.M. Breakthrough/ from envelope datum line as Sheet 05			49	dB
Subgroup B3 Performance at temperature	Inspection level S4 AQL 4% $T_{amb} = +85^{\circ}C$ and $-40^{\circ}C$ Tests and conditions as subgroup A2			Limits as per A2
GROUP C				
Subgroup C1 Life	Inspection level S3 AQL 4% 1000 hrs life at $T_{amb} = +85^{\circ}C$. Post test as sub-group A2.			
Vibration	8 hours $0.05 g^2/Hz$ 20-2000 ~ mounted by pins. Post test as subgroup A2			

* May be omitted on MSDS agreement of CTR's on structurally similar 00C BS9450 para. 2.3. refers.

CHECKED Hill	MARCONI SPACE AND DEFENCE SYSTEMS LTD. WARREN LANE, STANMORE, MIDDLESEX.	K1066	SECURITY CLASSIFICATION UNCLASSIFIED
DRAWN OSBORNE PICO			MSDS DRG. REF. 1065-31340-32-4 Sht. 04
APPROVED	TITLE MICROCIRCUIT, FILTER BANDPASS (NARROW BAND)		DRAWING NUMBER 138
QA			

CONNICON 10 JUN 1982

2. Characteristics (Not for inspection purposes)

The following characteristics apply over the temperature range of -40°C to 85°C and throughout the environmental conditions to para. 1. unless otherwise stated

Nominal Impedance 50 ohms
 Reference Frequency (F_R) @ 20°C 200 MHz \pm 60 kHz

Insertion Loss Datum (See sheet 05) 26 dB \pm 2.0dB

VSWR Input 6.0: 1 max^m
 Output TBA

Amplitude Characteristic See sheet 05.

Amplitude Tracking (gain adjusted over frequency range $F_R \pm 250$ kHz) 2dB max^m

Variation of Phase Tracking 12° max p.t.p.

(over the frequency range $F_0 \pm 250$ kHz between any two filters and shall not include any relative phase displacement between those filters).

Group Delay (90% amplitude, input and output) 3.0 \pm 0.25 μ S

E.M. Breakthrough (Pulse breakthrough input to output pins) Rejection measured from envelope datum as sheet 05, over the frequency range 10 - 1200 MHz 49 dB min^m

Pin Connections and Schematic Diagram

RF Input Pin 12
 Case Pin 1
 RF Output Pin 5
 Case Pin 7
 Case All remaining pins.

Weight 10.75 Grams max^m.

* Insert : Temperature variation of F_R \pm 60kHz
 I Insert : Insertion Loss variation
 The max pk-pk variation of I_{IL} over the full operating temp range

THE INFORMATION CONTAINED IN THIS DRAWING IS FURNISHED IN CONFIDENCE AND UNDER THE CONDITION THAT INDIVIDUALS AND COMPANIES ORIGINATING IN THE INFORMATION, WHETHER PATENTED OR NOT, WILL BE RESPECTED.

DATE	3-4-82
U	13-3-81
C	12-6-81
D	30-6-81
E	24-9-81
F	15-3-82

CON CON

DRAWN BORNE PCO	MARCONI SPACE AND DEFENCE SYSTEMS LTD. WARREN LANE, STANMORE, MIDDLESEX.	K1066	SECURITY CLASSIFICATION UNCLASSIFIED
			MSDS DRG. REF. 1065-31340-32-4 - Sht. 02
APPROVED	TITLE MICROCIRCUIT, FILTER, BANDPASS (NARROW BAND)		DRAWING NUMBER 139

3. Marking

- 3.1 Terminal Identification as on Sheet 01.
- 3.2 MSDS drawing Reference Number as below.
- 3.3 Makers Identification.
- 3.4 Serial Number or Date Code.

4. Related Documents

This specification shall be read in conjunction with:-

- BS 9000 "General requirements for electronic components of assessed quality".
- BS 9400 "Integrated electronic circuits of assessed quality".
- BS 9450 "Custom Build integrated electronic circuits of assessed quality".

5. Ordering Information

When ordering the following information will be quoted:-

Microcircuit filter, Narrow band Type to MSDS Specification number 1065-31340-32-4 and the current issue from sheet 01.

6. Quality Assurance Provisions

6.1 Certified Test Records

Group A test information and attribute information obtained during screening and batch/sample testing shall be made available to the MSDS QA Department on request.

6.2 Quality Assurance Requirements Group A (Subgroup AD screening)

100%

All devices shall be subjected to the test below in the sequence shown. They shall then meet the requirements of Groups A, B, before shipment and C following:- (BS9400 para. 1.2.9 level B refers internal pre-seal inspection BS 9450 Para. 1.2.10 condition B

Temperature Cycling (5 cycles) BS9450 para. 1.2.6.13 -40°C to 85°C

Leak Test BS9450 para. 1.2.6.14 5×10^{-7} atm

cm³/sq

THE INFORMATION CONTAINED IN THIS DRAWING IS FURNISHED IN CONFIDENCE AND UPON THE CONDITION THAT INDIVIDUAL AND CORPORATE RIGHTS ORIGINATING IN THE PATENT RIGHTS WHETHER PATENTED OR NOT, WILL BE RESERVED.

ISSUE	A	B	C
DATE	27-2-81	3-4-82	21-8-82
CKED			
OWN			
GORNE			
PIPCO			
LOVED			
DA			

CON CON 10 JUN 1982

MARCONI SPACE AND DEFENCE SYSTEMS LTD. WARREN LANE, STANMORE, MIDDLESEX.

K1066

SECURITY CLASSIFICATION

UNCLASSIFIED

MSDS DRG. REF.

1065-31340-32-4 Sht.03

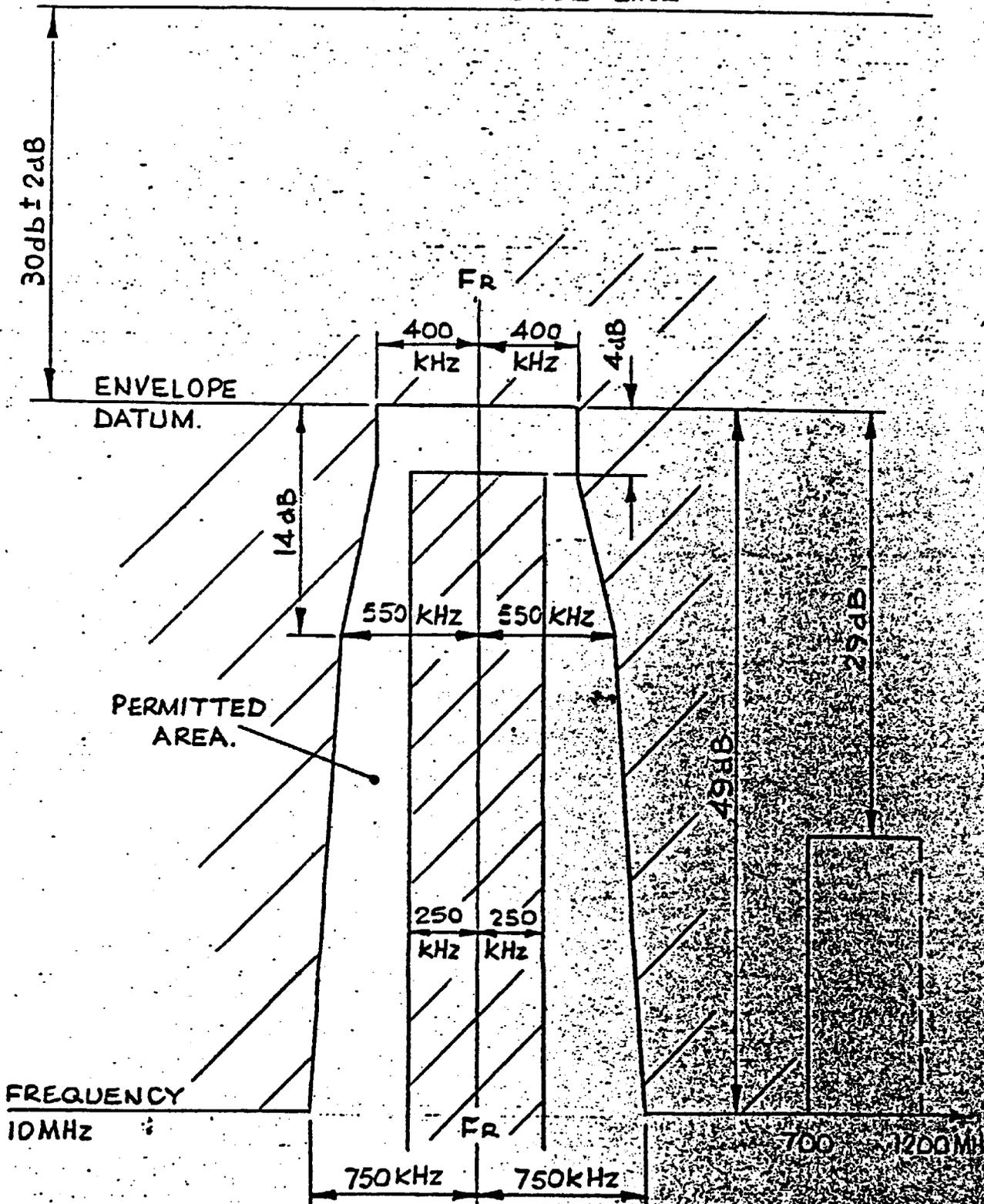
DRAWING NUMBER

140

MICROCIRCUIT, FILTER BANDPASS (NARROW BAND)

AMPLITUDE CHARACTERISTIC

0dB REFERENCE LINE



FR = REFERENCE FREQUENCY = 200 MHz ± DEVIATION

ISSUE	DATE	A	B	C	D	E
12-6-81	24-9-81	23-12-81	15-3-82	3-4-82		

MARCONI SPACE AND DEFENCE SYSTEMS LTD. WARREN LANE, STANMORE, MIDDLESEX.

K1066

SECURITY CLASSIFICATION UNCLASSIFIED

MSDS DRG. REF. 1065-31340-32-1 Sh: 05

TITLE MICROCIRCUIT, FILTER, BANDPASS (NARROW BAND)

DRAWING NUMBER 141

CON CON 10 JUN 1982

THE INFORMATION CONTAINED IN THIS DRAWING IS FURNISHED IN CONFIDENCE AND UNDER THE CONDITION THAT INDIVIDUAL AND COMPANY RIGHTS ORIGINATING IN THE INFORMATION, WHETHER PATENTED OR NOT, WILL BE RESPECTED.

Mr J Patrick
Mr J Holiday
Mr J Wallaw
Mr E Lead

VISIT TO GEC HIRST RESEARCH LABORATORIES, WEMBLEY 24 JUNE 1983

Purpose Thick Film and Monolithic Integrated Circuits to BS9450.
Continuation of BS9000 Audit of silicon on sapphire facility.
Maintenance of approval testing of MIC's and SAW's.
Miscellaneous points.

Present: Mr J Patrick, Quality Manager
Mr D Lewis,
Mr J Holiday, Deputy Quality Manager
Dr T Reynoldson, EQD SQO/ACL
Mr D Bush, EQD QO/Tla

During the visit Mr Bush performed the silicon on sapphire work.
Dr Reynoldson attended to other points.

Silicon on Sapphire. See separate notes produced by Mr Bush.

Maintenance of MIC's. CQC's 2-6 are either manufactured or nearly manufactured.
Some re-work of CQC 6 (Quartz) is required due to a metallization problem.

The replacement circuit for CQC 1, now designated CQC 8, is a spinel delay line. See earlier visit reports. Initial environmental testing has proved satisfactory, although the temperature range was not as wide as that required by the capability approval. However work will now progress. This requires finalisation of the specification and of the process instructions etc. Total timescale for manufacture is likely to be 2 months.

CQC's 2-6 will be sent to EMI for environmental conditions in approximately one week's time. Firm must ensure the correct paperwork is issued.

Maintenance of SAW's. A programme for manufacture and test has been issued. Work is on schedule despite there being a slight delay in the qualification of the lithium niobate crystals. Internal paperwork such as test specifications, build standard, definition and conversion of MEDL Lincoln drawings into Hirst Research drawings has yet to be completed.

The network analyser calibration period expires in approximately the time that the test exercise is to commence. It is hoped to extend the calibration date by performing measurements on stability of the instrument and obtaining a satisfactory history. The results to date are very encouraging.

The calibration procedure for the network analyser is to be modified so that the instruments does not require to be sent away. Internal standards will be used instead. In addition the calibration periodicity for these standards, currently 12 months, is to be reviewed.

The Firm must ensure that the environmental conditioning levels are comparable to those of the claimed capability.

Certificate of Conformity. The Firm had noted that they had produced 18 C of C's in the last 12 months, and 8 in the last 6 months. These are all for MIC's. However several similar devices were released to Defence Standard 05-21. Dr Reynoldson suggested that the Firm, in these cases, give a dual release.

European Space Agency. The Firm noted that they are being assessed by Marconi Portsmouth to supply silicon on sapphire and possibly SAW devices. Dr Reynoldson noted that he hoped that the exercise could be treated as a BS9000 approval with additional customer requirements. This would enable the Firm to maintain their approval when releasing circuits to the ESA requirements. The Firm will consider this point.

BS9000 Defective Components. Refer earlier visit reports concerning alleged defective due in line components purchased from National Semiconductor via a distributor. Dr Reynoldson noted that he had received a report from his colleague who supervises the original manufacturer. The report indicated that it was not necessary to reclaim all devices which had been incorporated into equipment.

Summary of Actions

1. MIC's. Firm progress maintenance of approval.
Firm ensure correct paperwork and company's devices.
2. EMI. Firm ensure that adequate environmental conditioning levels are applied.
3. SAW's. Firm continue maintenance of approval schedule.

Note. There is little breathing space in the timescale programme if the Firm are to complete this exercise in the time defined by Dr Reynoldson. See earlier correspondence.

Firm ensure that adequate environmental conditioning levels are applied to the devices.

Firm complete paperwork.

4. ESA. The Firm consider use of the BS9000 requirements for this work.
5. C of C's. The Firm consider dual release.
6. A further visit by Dr Reynoldson was arranged for Wednesday 3 August. Review of progress of maintenance will be the main topic.
7. Mr Dave Bush, QO/Tla, to write separate notes on silicon on sapphire circuits.

Distribution

ESB Files (General, MIC, SAW, and SOS Files)
EO/C
QO/Tla
Mr J Patrick, Hirst Research
Spare

Tim Reynoldson

T REYNOLDSON

RECEIVED
26 AUG 1983
RES. LABS.

EXHIBIT No. 3 (CTD.)

VISIT TO GEC HIRST RESEARCH LABORATORIES, WEMBLEY, 11 AUGUST 1983

Purpose Thick Film and Monolithic Integrated Circuits to BS9450

Dosimeters and other points

Sib

Present Mr J Patrick
Mr J Holliday
Mr D Lewis
Dr T Reynoldson EQD/SQO/AC1

JSP (2) JTL
JHH

SAW Maintenance

Refer the programme provided by the firm at the last meeting of 24 June 1983.

Manufacture of both CQC (ie. CQC4, Quartz and CQC5, lithium niobate) is progressing. The niobate CQC substrate was metallised, printed and etched during the course of the visit. If initial electrical tests are satisfactory the device will be boxed next week. Likewise the Quartz device will be boxed next week unless any setbacks occur. A small delay was incurred for both devices due to problems in the crystal polishing operation. The hot weather prevented a secure anchorage of the crystals to the polishing machine (obtained by using pitch, which softened in the hot weather) which caused uneven polishing, scratching etc. This was resolved by performing the polishing operation in temperature controlled environment.

CQC specifications have been drafted for both devices, together with a test programme.

A build standard will be defined. This will include both HRC and MEDL Lincoln drawings. It was agreed that the MEDL drawings need not be converted into HRC drawings. ||

Package sealing will not be performed at Wembley. CQC4 will be sealed at Lincoln and CQC5 at MEDL Portsmouth. In both instances Mr Lewis will witness the operation. Both sub-contractors are within the MEDL organisation and are BS9000 approved. (Subsequent note: If this situation is to re-occur in production conditions then a formal procedure must be written even though it is not a scheme of surveillance required for sub-contracting to non-approved source.)

The final test report need not be a formal BS9000 report with the BS9000 front page. However it was agreed that a normal BS9000 report would be raised in this case, and countersigned by Dr Reynoldson. The report will not include the process instructions.

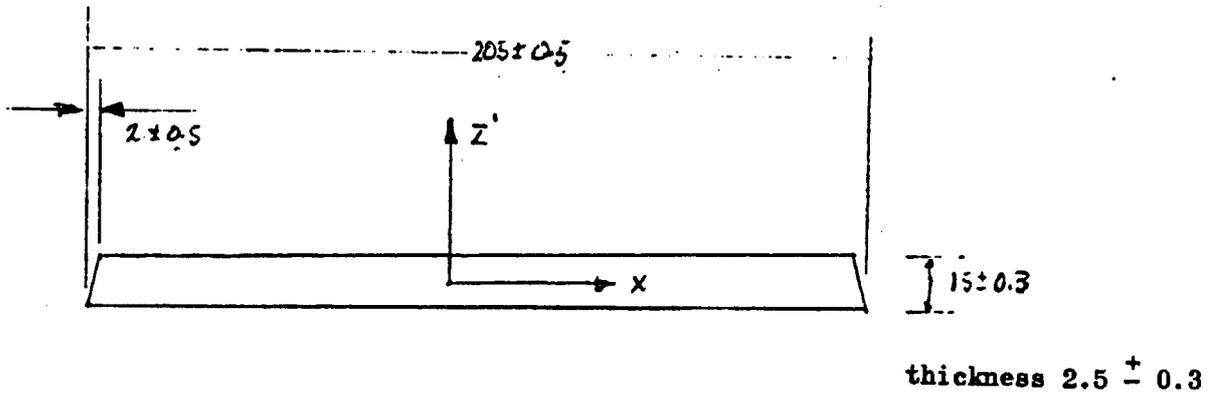
Environmental conditioning will be performed at EMI. Post test end points will however be performed at First Research which will require considerable handling of the devices between the two sides.

A tour of the SAW production facility was undertaken. The following notes are made.

Operations are performed in a clean room. This is not formally classified eg as Class 100. However operators are required to dress up and there is a formal airlock/changing area. The airflow is through the room from the end furthest from the entry door towards that door. Operations requiring the cleanest conditions are performed at the far end of the room. Several fume cupboards are required.

FIGURE

Orientation Requirements



Orientation of the Polished Face.

ST-cut axis Y' rotated $+ 42^{\circ} 45' \pm 15'$ from Y
 Each long edge \parallel with axis $\pm 15'$

All dimensions in millimetres.

Mr J H Holiday
Mr J H Swallow
Mr E Lead.

EXHIBIT No. 3 (CTD.)

VISIT TO GEC HIRST RESEARCH LABORATORIES, WEMBLEY 24 JUNE 1983

Purpose Thick Film and Monolithic Integrated Circuits to BS9450.

Continuation of BS9000 Audit of silicon on sapphire facility.

Maintenance of approval testing of MIC's and SAW's.

Miscellaneous points.

Present: Mr J Patrick, Quality Manager
 Mr D Lewis,
 Mr J Holiday, Deputy Quality Manager
 Dr T Reynoldson, EQD SQO/AC1
 Mr D Bush, EQD QO/T1a

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The lithium niobate wafers are normally of 3" in diameter. However due to flatness problems (maximum .5mm) the wafers are often cut to smaller sizes for printing. For this job the substrate was approximately 1 x 1/2".

Positive photoresist was used. The resist is spun over the substrate. As the substrate was not circular an even spread to all 4 corners of the substrate is not achievable. However each substrate contained approximately 8 device patterns from a much larger stepped and repeated screen. Patterns which are not adequately formed either due to etching or other problems are discarded. For this job 2 substrates were employed giving a total of approximately 16 patterns.

Points noted by Dr Reynoldson for consideration by the Firm are noted below:

1. Visual inspection: Currently this is performed to the satisfaction of the operator. Certain devices may tolerate far greater pattern errors than others eg short circuits, missing or broken fingers etc. However although this approach is ideal with respect to the application of each device, circuits which are to be released to BS9450 must also comply with the visual inspection requirements of BS9450.

2. Process instructions were defined when the original test programme was performed for BS9450 eg for CQCs 1, 2 and 3 etc. These instructions are still in use. However minor changes are required for the new device eg CQC5 and will be incorporated in the build standard for that device. Dr Reynoldson noted that although these instructions were available they were not in the clean room area. His preference was always for information to be available at the processing site.

3. It was noticed that several screens did not contain identification on the screen itself. Currently this may be of little consequence due to the number of screens involved in the total operation of the facility. In addition the screen container is identified. However it is likely that the throughput in the facility will increase and thus the potential for mixing screens will increase. The Firm noted that screens produced on the latest electron beam machine do now always carry identification.

4. The history of jobs is recorded in operator "blue books". It was not possible to locate the blue book for the BS9450 CQCs. The gentleman was on holiday. Dr Reynoldson noted that he would like to see this information at the next visit.

Quality Organisation

The quality manual revision is now complete. The document will contain the latest organisation charts. Copies of these charts were separately handed to Dr Reynoldson during the visit. The revised quality manual will be issued in approximately one month.

Dr Reynoldson agreed to send to Mr Patrick a copy of the latest EQD family tree.

MIC Maintenance

Testing is continuing for all devices except the delay line. Refer previous visit report. Assembly on the delay line will start tomorrow. As normal, only one device will be assembled initially in order to check that the delay line electrical characteristics are maintained after assembly. The remaining devices will be assembled in approximately 1 to 2 weeks time. Initial tests at the full claims temperature range have proved satisfactory. Mr Lewis noted that there have been no failures on testing of the other CQCs to date.

SOS

Progress on this approval will be reviewed by Dr Reynoldson and Mr Pulley on their next visit of 26 October 1983. Due to a slippage in the original test programme it is likely that wafer fabrication and/or testing may be in progress at that visit.

Dosimeters

The Firm have not yet issued the quality plan as they are awaiting comments from Fisher Controls Limited.

EQD Check Test

Dr Reynoldson noted that he wished to arrange a check test programme on MIC's. This would likely involve a member of the test laboratories visiting the Hirst Research Laboratories to witness testing rather than selecting samples to be tested at Aquila. Timescale approximately November 1983. Dr Reynoldson will organise the programme with Aquila.

Summary of Actions

1. Dr Reynoldson to organise check test.
2. Dr Reynoldson to send Mr Patrick a copy of family tree.
3. Mr Patrick to re-issue quality manual.
4. Dr Reynoldson to comment on SAW CQC specifications.
5. The Firm to consider points noted by Dr Reynoldson in his audit of the SAW facility and to provide the blue book for the next visit.
6. Firm to continue maintenance programme for SAW and MIC devices.
7. Firm to continue SOS programme.
8. Firm to issue quality plan for dosimeters on receipt of comments from customer.

Date of Next Meeting. Wednesday 26 October 1983. Dr Reynoldson and Mr Pulley will attend.

Distribution

ESB Files (BS9450 General File ie XW/1175/M; XW1175/CA001, XW/1175/CA002, C/4/1/079; 16/1/0197)

EO/C

SQO/T1

Mr J Patrick, Hirst Research - + Family Tree.

Spare for Dr Reynoldson

Tim Reynoldson

T REYNOLDSON

GEC RESEARCH LABORATORIES

HIRST RESEARCH CENTRE

WEMBLEY

17th May 1983

To: Mr J B Patrick

Copies to:

Dr D V McCaughan
Dr E Read
Mr D E Hooper
Mr A L Haston
Mr F S McClemont
Mr A J Dyer
Mr J H Holliday
Mr T H Oxley MEDL, Lincoln
Mr S I Neylon MEDL, Lincoln
Mr J Anderson MEDL, Lincoln

Ref BS9450 Capability - SAW Devices

The contents of the letter from DCVD Ref XW/1175/CA002 were discussed during a technical liaison meeting at MEDL yesterday. The importance of maintaining our capability for SAW filters was recognised but MEDL were unable to allocate specific funds to underwrite this exercise.

Following discussion, Mr Oxley indicated that it would be acceptable to use a proportion of the current SAW filter research budget in support of the work. In the absence of any other source of funding I propose to re-allocate a proportion of the cost against GEC supported contracts within the Piezoelectric Department which would benefit from the exercise.

Please note that the proposed approval exercise has been costed for approximately £10K; this does not include QA support or test house expenditure which I trust you can fund from your own resources.



Arthur Dyer
Piezoelectric Department

SPECIAL DEVICES DIVISION

Manager Dr E Read External Consultants J F Werner
J K Stevenson

Secretary Mrs I Weetch

SPECIAL TECHNIQUES DEPT

Dept Head G H Swallow (421)

- D Wilde
- B Barnes
- R Millea
- K Arbor
- K Page
- M Savage
- J Latcham
- B A Eubank

PIEZOELECTRIC DEPT

Dept Head A J Dyer

R C Peach
Research Associate

SAW Group (431)
F S McClement

R T Biggs
N Doggett
A Katsellis

Topic
Bridgmanhead
Filters

Tomado (MSDS/MCU)
BS 9450 CUD/BS4000 Bulk

L.L. Filters
CUD,
MSDS
McM.

Cement
Determinants [BF]
Demonstrator (s)

Resonator Product Launch (433)
A Haston

S Morris
A N Other

Topic
High quality
QC. resonators

Bulk & A/O Devices (439)
A J Dyer

J Bagshaw
A Byrne
N Goodwin
A N Other
A N Other

Topics
Q.C. Design
Q.C. Technology
Q.C. Liaison
E.O.W.F.
High FQR.

Piezoelectric Materials (434)
S P Doherty

C Emin

Topic
High Purity
Quartz
Xtal Growth/
Characterisation
Lithium
Tetrafluoride

Chemical Sensors (432)
G Rogers

T W Beck
R A Davies
A Nott
L Westcott

Mechanical Sensors
E Read (437)

A McGeown
M Klina
D Ritchie

Temperature Sensors
M Frost (438)

A Hansom

Optical Polishing Group
L T Boxall (426)

R Milkie
L Keeley
J Geiger
B J S Campion
A R Lowder
F J Newman
W J Worlidge
J Murphy
P Bensenltnck

EXHIBIT No. 3

(CTD.)

EOL-SAW 4

INSPECTION OR TEST	
<u>PRE-ASSEMBLY : 100% TEST - BS 9450 1.2.10.1</u>	
1	SUBSTRATE LENGTH
2	" WIDTH
3	" HEIGHT
4	" CRACKS 1.2.10.1.1 (a)
5	" CHIP-OUTS 1.2.10.1.1 (b)
6	UNDER/OVER ETCHING
7	SHORT-CIRCUIT FINGER PAIRS 1.2.10.1.1 (d)
8	OPEN-CIRCUIT FINGERS 1.2.10.1.1 (d)
9	SUBSTRATE SURFACE BLEMISHES
10	PATTERN LOCATION ON SUBSTRATES 1.2.10.1.1 (c)
11	CONDUCTOR THICKNESS
<u>POST-ASSEMBLY 100% TEST BS9450 1.2.10.2.</u>	
12	SOLDERING 1.2.10.2.3.
13	WIRE BONDING
14	PACKAGE CONDITION (PRE-LID VISUAL)
15	R.F. TEST (PRE-LID)
16	PACKAGE CONDITION. (POST-LID VISUAL)
<u>VISUAL : BS 9450 GROUP A1</u>	
17	CORRECTNESS OF MARKING
18	" " TERMINAL IDENTIFICATION
19	" " ENCAPSULATION
20	UNBROKEN BODY
<u>ELECTRICAL (ROOM TEMPERATURE) BS9450 GROUP A2.</u>	
21	REFERENCE FREQUENCY.
22	BANDWIDTH
23	INSERTION LOSS
24	GROUP DELAY
25	OUT OF BAND REJECTION (RELATIVE TO PASSBAND).
26	RIPPLE
27	<u>SOLDERABILITY.:</u> BS 9450 GROUP B1 (a)
<u>DIMENSIONS : BS 9450 GROUP B1 (b)</u>	
28	CASE LENGTH
29	" WIDTH
30	" HEIGHT
31	WEIGHT.
32	<u>TERMINAL ROBUSTNESS :</u> BS 9450 GROUP B3
<u>ENVIRONMENTAL</u>	
33	RAPID CHANGE OF TEMPERATURE
34	DAMP HEAT - CYCLIC
35	ACCELERATION STEADY STATE
36	SHOCK
37	VIBRATION - STEAD STATE.
38	VIBRATION - SWEEP
39	HUMIDITY
40	ENDURANCE
<u>ELECTRICAL (AT MAXIMUM AND MINIMUM TEMPERATURES)</u>	
41	REFERENCE FREQUENCY
42	BANDWIDTH
43	INSERTION LOSS
44	GROUP DELAY
45	OUT OF BAND REJECTION (RELATIVE TO PASSBAND)
46	RIPPLE

<p>BRITISH STANDARDS INSTITUTION 2 PARK STREET, LONDON W1A 2BS</p>	<p>BS 9450 SAW CRC</p>
<p>SPECIFICATION AVAILABLE FROM: S.E.C. HIRST RESEARCH CENTRE, EAST LANE, WEMBLEY, MIDDLESEX. HA9 7PP</p>	<p>ISSUE AUGUST 1983</p> <p>PAGE 1 OF PAGES</p>
<p>ELECTRONIC COMPONENTS OF ASSESSED QUALITY. DETAIL SPECIFICATION IN ACCORDANCE WITH BS 9450 APPENDIX E.</p>	<p>MANUFACTURERS TYPE NUMBER SAW 4</p> <p>FOR ORDERING INFORMATION SEE P.2.</p>
<p>OUTLINE & DIMENSIONS. THIRD ANGLE PROJECTION.</p>	<p>SURFACE ACOUSTIC WAVE NARROW-BAND FILTER, FOUR TERMINAL PASSIVE DEVICE, METAL BOX, WELDED SEALED LID, QUARTZ SUBSTRATE.</p>
<p>ALL DIMENSIONS IN MM. WEIGHT GMS. FOR DETAIL DIMENSIONS SEE DRAWING PAGE MARKING INFORMATION SEE PAGE 2.</p>	<p>FULL ASSESSMENT.</p>

1. DESCRIPTION OF CAPABILITY MAINTAINANCE QUALIFYING CIRCUIT (CQC).

THE CQC-SAW4 IS A SURFACE WAVE ST-CUT QUARTZ NARROW BAND FILTER WITH A CENTRE FREQUENCY OF 200 MHz. THIS FILTER FORMS PART OF AN IF RECEIVER, AND REQUIRES AN INTEGRAL MATCHING NETWORK TO OPTIMISE CLAIMED RESPONSE.

THIS CQC DEMONSTRATES THE CAPABILITY OF ASSEMBLING, TUNING AND ENCAPSULATING A NARROW BAND SAW FILTER WHICH CAN BE SUBJECTED TO TESTING TO SATISFY CUSTOMER'S REQUIREMENTS -

LIMITING CONDITIONS OF USE (NOT FOR INSPECTION PURPOSES).ABSOLUTE MAXIMUM VALUES.

RF INPUT POWER	+ 20 dBm FOR 0.5 SECONDS
OPERATING TEMPERATURE RANGE	- 40°C TO + 85°C
STORAGE TEMPERATURE RANGE	- 50°C TO + 90°C
VIBRATION (OPERATING)	± 10g 30 Hz TO 2000 Hz.
SHOCK (NON-OPERATING)	30g 11 MS
HUMIDITY	BS 2011 56 DAYS
LEAD TEMPERATURE (SOLDERING - 10 SECONDS)	260°C

3. RECOMMENDED CONDITIONS OF USE AND ASSOCIATED CHARACTERISTICS.

THE FOLLOWING CHARACTERISTICS APPLY OVER THE TEMPERATURE RANGE OF -40°C TO +85°C AND THROUGHOUT THE ENVIRONMENTAL CONDITIONS TO PARA. 1. UNLESS OTHERWISE STATED.

SOURCE IMPEDANCE	50 OHMS
LOAD IMPEDANCE	50 OHMS
REFERENCE FREQUENCY (FR) AT 20°C	200 MHz ± 60 KHz
BANDWIDTH	600 KHz
TEMPERATURE VARIATION OF FR	± 60 KHz.
INSERTION LOSS	26 dB ± 2.0 dB
MAXIMUM Pk TO Pk VARIATION OF INSERTION LOSS OVER FULL OPERATING TEMPERATURE RANGE	2 dB
GROUP DELAY	3.0 ± 0.25/AS.
FINISH	GOLD PLATED

PIN CONNECTIONS AND SCHEMATIC DIAGRAM.

RF INPUT	PIN 12
CASE	PIN 1
RF OUTPUT	PIN 6
CASE	PIN 7
CASE	ALL REMAINING PINS.

WEIGHT 10.75 GRAMS MAX.

4. MARKING

4.1. EACH S.A.W. DEVICE SHALL BEAR THE FOLLOWING MARKINGS:

- (a) TERMINAL IDENTIFICATION
- (b) MANUFACTURER'S TYPE NUMBER.
- (c) SERIAL NUMBER
- (d) FACTORY IDENTIFICATION

4.2. EACH PRIMARY PACKAGE CONTAINING ONE OR MORE OF THESE DEVICES SHALL BEAR ALL THE ABOVE MARKINGS EXCEPT (a) AND IN ADDITION:-

THE BRITISH STANDARD DETAIL SPECIFICATION NUMBER.

5. ORDERING INFORMATION

ORDERS FOR THE SAW DEVICES SHALL CONTAIN THE FOLLOWING INFORMATION:

- (a) QUANTITY
- (b) TYPE NUMBER
- (c) CENTRE FREQUENCY
- (d) THE BRITISH STANDARD SPECIFICATION NUMBER.

6. RELATED DOCUMENTS.

THIS SPECIFICATION SHALL BE READ IN CONJUNCTION WITH:

BS 2011 METHODS FOR ENVIRONMENTAL TESTING OF ELECTRONIC COMPONENTS AND ELECTRONIC EQUIPMENT.

BS 3934 DIMENSIONS OF SEMICONDUCTOR DEVICES.

BS 9000 SEMICONDUCTOR DEVICES OF ASSESSED QUALITY

155

BS 9000 GENERAL REQUIREMENTS FOR ELECTRONIC COMPONENTS OF ASSESSED QUALITY

- BS 9400 INTEGRATED ELECTRONIC CIRCUITS OF ASSESSED QUALITY.
GENERIC DATA AND METHODS OF TEST
- BS 9450 CUSTOM BUILT INTEGRATED CIRCUITS OF ASSESSED QUALITY.
(ISSUE 2) GENERIC DATA AND METHODS OF TEST.
- G.E.C. HIRST RESEARCH CENTRE SAW CAPABILITY MANUAL.
- BS 9600 PIEZOELECTRIC CRYSTAL FILTERS OF ASSESSED QUALITY.
GENERIC DATA AND METHODS OF TEST.

7. INSPECTION REQUIREMENTS.

- 7.1 WHERE A SUBGROUP CONTAINS MORE THAN ONE TEST THE ORDER OF TESTS IS MANDATORY.
- 7.2. AMBIENT TEMPERATURE TO BE $+15^{\circ}\text{C}$ TO $+35^{\circ}\text{C}$ UNLESS OTHERWISE STATED
- 7.3 SHOCK, VIBRATION AND ACCELERATION TESTS ARE CARRIED OUT WHEREVER POSSIBLE WITH SAW DEVICES CLAMPED SECURELY BY ITS NORMAL MOUNTING ARRANGEMENT.
- 7.4. SAMPLES SUBJECTED TO DESTRUCTIVE TESTS MARKED 'D' SHALL NOT BE RELEASED UNDER BS 9000 (SEE 2.6.5 OF BS 9000 PART.1.).
- 7.5 CERTIFIED TEST RECORDS SHALL BE KEPT BY THE MANUFACTURER FOLLOWING THE PRINCIPLES OF BS 9000. THESE WILL BE RETAINED BY THE MANUFACTURER BUT SHALL BE AVAILABLE FOR SCRUTINY BY THE CUSTOMER'S AUTHORISED QA REPRESENTATIVE. THE FORMAT FOR THE TEST RECORDS SHALL BE MUTUALLY AGREED.

INSPECTION REQUIREMENTS

SPECIFICATION ISSUE 1

ALL TESTS SHALL BE CARRIED OUT AT $T_{AMB} = 25^{\circ}C \pm 5^{\circ}C$ UNLESS OTHERWISE SPECIFIED.

EXAMINATION OR TEST	REFERENCE No 9450	CONDITIONS OF TEST	SYM.	LIMITS		UNITS
				MIN	MAX	
<u>A1</u>		<u>GROUP A</u>				
1. <u>DIMENSIONS</u>	1.2.3	CASE LENGTH CASE WIDTH CASE HEIGHT	L W H			MM MM MM
2. <u>VISUAL INSPECTION</u>	1.2.2.	(a) CORRECTNESS OF MARKING (b) CORRECTNESS OF TERMINAL IDENTIFICATION (c) CORRECTNESS OF ENCAPSULATION (d) UNBROKEN BODY				
<u>A2</u>		<u>MAJOR STATIC/DYNAMIC CHARACTERISTICS AT ROOM TEMP.</u>				
1. <u>REFERENCE FREQUENCY</u>			FR	199	201	KHZ
2. <u>BANDWIDTH</u>		AT 3dB FROM MAXIMUM TRANSMISSION		500		KHZ
3. <u>INSERTION LOSS</u>				24	28	dB
4. <u>GROUP DELAY</u>				2.75	3.25	μS
5. <u>OUT OF BAND REJECTION (RELATIVE TO PASSBAND)</u>		FROM 10 KHZ TO FR - 750 KHZ FROM FR + 750 KHZ TO 700 KHZ FROM 700 KHZ TO 1200 KHZ		49 49 29		dB. dB dB
<u>C. RIPPLE</u>		THROUGHOUT BAND			1.5	dB.
<u>B1(a)</u>						
<u>SOLDERABILITY</u>	1.2.6. 15.1.	ON AT LEAST TWO LEADS OF ONE TEST SPECIMEN.				

INSPECTION REQUIREMENTS

ALL TESTS SHALL BE CARRIED OUT AT $T_{AMB} = 25^{\circ}C \pm 5^{\circ}C$ UNLESS OTHERWISE SPECIFIED.

EXAMINATION OR TEST	REFERENCE N ^o 9450	CONDITIONS OF TEST	SYM.	LIMITS		UNITS
				MIN	MAX	
<u>GROUPO B (CONT)</u> B1 (6) WEIGHT	1.2.3		Wt.		10-75	GRAMS.
<u>B2</u> <u>RAPID CHANGE OF TEMPERATURE</u> <u>DAMP HEAT</u> <u>CYCLIC</u>	1.2.6.13 1.2.6.5. (BS 2011 TEST 36)	3 CYCLES - EACH CYCLE COMPRISING 10 MIN AT $-40^{\circ}C$ 10 MIN AT $+85^{\circ}C$ TRANSFER TIME 6 MIN. MAX. CONDITIONS AS SUBGROUP A2. 6 CYCLES UPPER TEMP. $+55^{\circ}C$				
<u>B3</u> <u>TERMINAL ROBUSTNESS</u>	1.2.6.16					
<u>B4</u> <u>ACCELERATION (STEADY STATE)</u>	1.2.6.9. (BS 2011 TEST 9a)	1. ACCELERATION $1960 m/s^2$ 2. DIRECTION ALONG Y AXIS 3. MOUNTING - NORMAL FIXING 4. TIME - NOT LESS THAN 10 S.				
<u>B5</u> <u>ENDURANCE</u>		160 HOURS. TEMPERATURE $+85^{\circ}C$				
<u>B6</u> <u>POST TEST END POINTS FOR B2, B4, B5</u>		AS FOR SUBGROUP A2				
<u>B7</u> <u>CTR INFORMATION</u>		ATTRIBUTES INFORMATION - SUBGROUPS B1, B2, B4, B5.				

INSPECTION REQUIREMENTS

ALL TESTS SHALL BE CARRIED OUT AT $T_{AMB} = 25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ UNLESS OTHERWISE SPECIFIED.

EXAMINATION OR TEST	REFERENCE N ^o	CONDITIONS OF TEST	SYM.	LIMITS		UNITS
				MIN	MAX	
<u>C1(a)</u> <u>VIBRATION</u> <u>(STEADY)</u>	1.2.6.8.2.	<u>GROUP C</u> 98 $\mu\text{/s}^2$ (10 g) 2 HOURS IN EACH OF 3 MUTUALLY PERPENDICULAR AXES.				
<u>SHOCK</u>	1.2.6.6	ACCELERATION 190 $\mu\text{/s}^2$ $\frac{1}{2}$ SINE WAVE PULSE DURATION 11 MS. THREE SHOCKS IN EACH DIRECTION. 2-2 18 SHOCKS				
<u>DAMP HEAT</u> <u>CYCLIC</u>	1.2.6.5. (BS 2011 TEST D6)	6 CYCLES UPPER TEMPERATURE $+55^{\circ}\text{C}$				
<u>C2(a)</u> <u>C2(b)</u>		SUBGROUP A2 TESTS AT $+85^{\circ}\text{C}$ AND -40°C				
<u>C3</u> <u>ENDURANCE</u>		2000 HOURS. TEMP $+85^{\circ}\text{C}$				
<u>C4</u> <u>POST TEST END</u> <u>POINTS FOR</u> <u>C1 AND C3</u>		AS FOR SUBGROUP A2.				
<u>C5</u> <u>CTR INFORMATION</u>		ATTRIBUTES INFORMATION - SUBGROUPS C1 AND C3				
<u>D1(a)</u> <u>VIBRATION</u> <u>(SWEEP)</u>	1.2.6.8.1.	<u>GROUP D</u> FREQUENCY: 10Hz TO 2000Hz ACCELERATION: 98 $\mu\text{/s}^2$ DURATION: 2 HOURS IN EACH OF 3 MUTUALLY PERPENDICULAR AXES. MOUNTING: NORMAL.				

INSPECTION REQUIREMENTS

ALL TESTS SHALL BE CARRIED OUT AT $T_{AMB} = 25^{\circ}C \pm 5^{\circ}C$ UNLESS OTHERWISE SPECIFIED.

EXAMINATION OR TEST	REFERENCE N ^o 9450	CONDITIONS OF TEST	SYM.	LIMITS		UNITS
				MIN	MAX	
D1(a) Cont HUMIDITY	BS 2011 TEST Ca	55°C 56 DAYS				
D3 RESISTANCE TO SOLDER HEAT	2.6.15.2	265°C - 10 SECONDS				
D4 ENDURANCE		8000 HOURS. TEMP = +85°C				
D5 POST TEST END POINTS FOR D1, D3, D4		AS FOR SUBGROUP A2				
D6 CTR INFORMATION		ATTRIBUTES INFORMATION - SUBGROUPS D1, D3, D4				

BRITISH STANDARDS INSTITUTION 2 PARK STREET, LONDON W1A 2BS.	BS 9450 SAW CQC ISSUE AUGUST 1983
SPECIFICATION AVAILABLE FROM: G.E.C. HIRST RESEARCH CENTRE, EAST LANE, WEMBLEY, MIDDLESEX. HA9 7PP.	PAGE 1 OF 10 PAGES.
ELECTRONIC COMPONENTS OF ASSESSED QUALITY. DETAIL SPECIFICATION IN ACCORDANCE WITH BS9450 APPENDIX E.	MANUFACTURERS TYPE NUMBER SAW 5 FOR ORDERING INFORMATION SEE P.2
OUTLINE & DIMENSIONS. THIRD ANGLE PROJECTION. ALL DIMENSIONS IN MM. WEIGHT GMS. FOR DETAIL DIMENSIONS SEE DRAWING PAGE MARKING INFORMATION SEE PAGE 2.	SURFACE ACOUSTIC WAVE WIDE-BAND BAND FILTER FOUR TERMINAL PASSIVE DEVICE PRECISION METAL BOX WELDED SEALED LD. LITHIUM NIOBATE SUBSTRATE. FULL ASSESSMENT.

1. DESCRIPTION OF CAPABILITY MAINTAINANCE QUALIFYING CIRCUIT (CQC)

THE CQC - SAW 5 IS A SURFACE WAVE LITHIUM NIOBATE WIDE-BAND FILTER WITH A CENTRE FREQUENCY OF 120 MHz. THIS FILTER IS INTENDED TO FORM PART OF AN IF RECEIVER AND THE FILTER DETERMINES THE SYSTEM BANDWIDTH.

BECAUSE OF THE NON-CRITICAL EFFECT OF INPUT AND OUTPUT IMPEDANCE MATCHING ON THE PERFORMANCE OF THIS FILTER, NO MATCHING NETWORKS ARE REQUIRED.

THIS CQC DEMONSTRATES THE CAPABILITY OF ASSEMBLING AND ENCAPSULATING A WIDE-BAND SURFACE ACOUSTIC WAVE DEVICE WITH WHICH CAN BE SUBJECTED TO VIB TESTING TO SATISFY CUSTOMERS REQUIREMENTS.

2. LIMITING CONDITIONS OF USE (NOT FOR INSPECTION PURPOSES)

TAMB OPERATING TEMPERATURE RANGE	-26°C TO +80°C
TSTG TEMPERATURE RANGE	-40°C TO +85°C
INPUT AT THE REFERENCE FREQUENCY	20 dBm . MAX.
SHOCK	490 m/s ² , 11 ms.
VIBRATION	10 Hz TO 2000 Hz
MOUNTING POSITION	ANY

3. RECOMMENDED CONDITIONS OF USE AND ASSOCIATED CHARACTERISTICS

REFERENCE FREQUENCY	120	MHz
INSERTION LOSS	21	dB
BANDWIDTH (-3dB)	10	MHz
ATTENUATION AT 110 MHz AND 130 MHz	20	dB
PEAK SIDE LOBE LEVELS	-50	dB
FINAL ATTENUATION AND SPURIOUS OUTPUTS	50	dB
BANDPASS RIPPLE	FLAT TO WITHIN ± 1.5 dB THROUGHOUT BAND	
GROUP DELAY	c. b. c.	
SOURCE IMPEDANCE	50	OHMS
LOAD IMPEDANCE	50	OHMS
FINISH	GOLD PLATED.	

4. MARKING

4.1 EACH S.A.YI. DEVICE SHALL BEAR THE FOLLOWING MARKINGS:

- TERMINAL IDENTIFICATION
- MANUFACTURER'S TYPE NUMBER.
- SERIAL NUMBER.
- FACTORY IDENTIFICATION.
- NOMINAL CENTRE FREQUENCY.

- 4.2. EACH PRIMARY PACKAGE CONTAINING ONE OR MORE OF THESE DEVICES SHALL BEAR ALL THE ABOVE MARKINGS EXCEPT (a) AND IN ADDITION :-
THE BRITISH STANDARD DETAIL SPECIFICATION NUMBER.

5. ORDERING INFORMATION

ORDERS FOR THE SAW DEVICES SHALL CONTAIN THE FOLLOWING INFORMATION.

- (a) QUANTITY
- (b) TYPE NUMBER
- (c) CENTRE FREQUENCY
- (d) THE BRITISH STANDARD SPECIFICATION NUMBER.

6. RELATED DOCUMENTS.

THIS SPECIFICATION SHALL BE READ IN CONJUNCTION WITH :

BS 2011 METHODS FOR ENVIRONMENTAL TESTING OF ELECTRONIC COMPONENTS AND ELECTRONIC EQUIPMENT.

BS 3934 DIMENSIONS OF SEMICONDUCTOR DEVICES

BS 9000 GENERAL REQUIREMENTS FOR ELECTRONIC COMPONENTS OF ASSESSED QUALITY.

BS 9300 SEMICONDUCTORS DEVICES OF ASSESSED QUALITY.

BS 9400 INTEGRATED ELECTRONIC CIRCUITS OF ASSESSED QUALITY. GENERIC DATA AND METHODS OF TEST.

BS 9450 CUSTOM BUILT INTEGRATED CIRCUITS OF ASSESSED (ISSUE 2.) QUALITY. GENERIC DATA AND METHODS OF TEST.

G.E.C. HIRST RESEARCH CENTRE SAW CAPABILITY MANUAL

BS 9600 PIEZOELECTRIC CRYSTAL FILTERS OF ASSESSED QUALITY. GENERIC DATA AND METHODS OF TEST.

7. INSPECTION REQUIREMENTS

- 7.1. WHERE A SUBGROUP CONTAINS MORE THAN ONE TEST THE ORDER OF TESTS IS MANDATORY.

- 7.2. AMBIENT TEMPERATURE TO BE $+15^{\circ}\text{C}$ TO $+35^{\circ}\text{C}$ UNLESS OTHERWISE STATED.
- 7.3. SHOCK, VIBRATION AND ACCELERATION TESTS ARE CARRIED OUT WHEREVER POSSIBLE WITH S.A.V. DEVICES CLAMPED SECURELY BY THEIR NORMAL MOUNTING ARRANGEMENT.
- 7.4. SAMPLES SUBJECTED TO DESTRUCTIVE TESTS MARKED 'D' SHALL NOT BE RELEASED UNDER BS 9000 (SEE 2.6.5 OF BS 9000) PART 1.
- 7.5. CERTIFIED TEST RECORDS SHALL BE KEPT BY THE MANUFACTURER FOLLOWING THE PRINCIPLES OF BS 9000. THESE WILL BE RETAINED BY THE MANUFACTURER BUT SHALL BE AVAILABLE FOR SCRUTINY BY THE CUSTOMER'S AUTHORISED QA REPRESENTATIVE. THE FORMAT FOR THE TEST RECORDS WILL BE MUTUALLY AGREED.

ALL TESTS SHALL BE CARRIED OUT AT $T_{AMB} = 25^{\circ}C \pm 5^{\circ}C$ UNLESS OTHERWISE SPECIFIED.

EXAMINATION OR TEST	REFERENCE NO 9450	CONDITIONS OF TEST	SYM.	LIMITS		UNITS
				MIN	MAX	
<u>GROUP A</u>						
<u>A1</u> <u>DIMENSIONS</u>	1.2.3.	CASE LENGTH CASE WIDTH CASE HEIGHT	L W H			mm mm mm
2. <u>VISUAL INSPECTION</u>	1.2.2	a) CORRECTNESS OF MARKING b) CORRECTNESS OF TERMINAL IDENTIFICATION c) CORRECTNESS OF ENCAPSULATION d) UNBROKEN BODY				
<u>A2</u> <u>ELECTRICAL</u>		MAJOR STATIC/DYNAMIC CHARACTERISTICS AT ROOM TEMP.				
1. REFERENCE FREQUENCY		INPUT LEVEL + 10dBm	RF	115	125	MHz
2. PASS BANDWIDTH		3 dB POINTS (FROM MAXIMUM TRANSMISSION)		9.5	10.5	MHz
3. INSERTION LOSS		INPUT LEVEL + 10 dB		20.7	21.7	dB
4. RIPPLE		THROUGHOUT BAND			1.5	dB
5. OUT OF BAND REJECTION. (RELATIVE TO PASS BAND)		a) ATTENUATION AT 110 MHz AND 130 MHz b) PEAK SIDE LOBE LEVELS c) FINAL ATTENUATION AND SPURIOUS OUTPUTS		20	-50	dB dB dB
50						
<u>B1</u> SOLDERABILITY	1.2.6.15.1	METHOD C. B. d.				

INSPECTION REQUIREMENTS

ALL TESTS SHALL BE CARRIED OUT AT $T_{AMB} = 25^{\circ}C \pm 5^{\circ}C$ UNLESS OTHERWISE SPECIFIED.

EXAMINATION OR TEST	REFERENCE N ^o -9450	CONDITIONS OF TEST	SYM.	LIMITS		UNITS
				MIN	MAX	
<u>B2</u> <u>RAPID CHANGE OF TEMPERATURE</u>	1.2.6.13.1	5 CYCLES - EACH CYCLE COMPRISING 10 MIN AT $-35^{\circ}C$ 10 MIN AT $+80^{\circ}C$ TOTAL TRANSFER TIME FROM $-35^{\circ}C$ TO $+80^{\circ}C$ OR REVERSE TO BE 6 MIN.				
<u>PEAK TEST</u> <u>MP HEAT</u> <u>CYCLIC</u>	1.2.4.16 1.2.6.5 (BS2011 TEST D6)	3 6 CYCLES UPPER TEMPERATURE $+55^{\circ}C$.			5×10^{-7}	ATMS/ CM ³ /S
<u>B3</u> <u>TERMINAL ROBUSTNESS (D)</u>	1.2.6.16. (BS2011 TEST U)					
<u>B4</u> <u>ACCELERATION STEADY STATE.</u>	1.2.6.9 (BS2011 TEST 9a)	(i) ACCELERATION $1960 m/s^2$ (ii) DIRECTION OF ACCELERATION ALONG Y AXIS (iii) MOUNTING WITH NORMAL FIXING. (iv) TIME NOT LESS THAN 10S.				
<u>B5</u> <u>ENDURANCE</u>		160 HOURS. NON-OPERATING TEMPERATURE $+80^{\circ}C$.				

INSPECTION REQUIREMENTS

ALL TESTS SHALL BE CARRIED OUT AT $T_{AMB} = 25^{\circ}C \pm 5^{\circ}C$ UNLESS OTHERWISE SPECIFIED.

EXAMINATION OR TEST	REFERENCE N ^o 9450	CONDITIONS OF TEST	SYM.	LIMITS		UNITS
				MIN	MAX	
<p><u>B6</u> POST TEST END POINTS FOR B2, B4, B5.</p> <p>1. CENTRE FREQUENCY</p> <p>2. PASS BANDWIDTH</p> <p>3. INSERTION LOSS</p> <p>4. OUT OF BAND REJECTION (RELATIVE TO PASS BAND)</p> <p>5. RIPPLE</p>		<p>INCLUDES ALL TESTS IN SUBGROUP A2 (AT ROOM TEMP.)</p> <p>INPUT LEVEL + 10 dBm.</p> <p>3 dB POINTS</p> <p>INPUT LEVEL + 10 dB</p> <p>ATTENUATION 110 TO 130 MHz</p> <p>PEAK SIDE LOBE LEVELS</p> <p>FINAL ATTENUATION AND SPURIOUS OUTPUTS</p> <p>THROUGHOUT BAND</p>		<p>115</p> <p>9.5</p> <p>20.7</p> <p>20</p> <p>50</p>	<p>125</p> <p>10.5</p> <p>21.7</p> <p>-50</p> <p>1.5</p>	<p>MHz</p> <p>MHz</p> <p>dB</p> <p>dB</p> <p>dB</p> <p>dB</p>
<p><u>B7</u> CTR INFORMATION.</p>		<p>ATTRIBUTES INFORMATION FROM SUBGROUPS B1, B2, B4, B5</p>				
<p><u>C1(a)</u> VIBRATION</p> <p><u>SHOCK</u></p> <p><u>DAMP HEAT STEADY STATE</u></p>	<p>1.2.6.8.2.</p> <p>1.2.6.6</p> <p>BS 2011 (TEST Ca)</p>	<p><u>GROUP C</u></p> <p>98 m/s² (10g)</p> <p>2 HOURS IN EACH OF 3 MUTUALLY PERPENDICULAR AXES</p> <p>ACCELERATION 490 m/s²</p> <p>HALF SINE-WAVE</p> <p>PULSE DURATION 11 ms. THREE SUCCESSIVE SHOCKS IN EACH DIRECTION OF THREE MUTUALLY PERPENDICULAR AXES. (I.E. 18 SHOCKS).</p> <p>TEMP. +55°C</p> <p>DURATION: 56 DAYS.</p>				

SPECIFICATION ISSUE

INSPECTION REQUIREMENTS

ALL TESTS SHALL BE CARRIED OUT AT $T_{AMB} = 25^{\circ}C \pm 5^{\circ}C$ UNLESS OTHERWISE SPECIFIED.

EXAMINATION OR TEST	REFERENCE No. 9450	CONDITIONS OF TEST	SYM.	LIMITS		UNITS
				MIN	MAX	
C2a						
<u>SUBGROUPS A2 AT +80°C</u>						
1) <u>CENTRE FREQUENCY</u>		INPUT LEVEL + 10 dBm.		115	125	MHz
2) <u>PASS BANDWIDTH</u>		3 dB POINTS		9.5	10.5	MHz
3) <u>INSERTION LOSS</u>		INPUT LEVEL + 10 dB		20.7	21.7	dB
4) <u>OUT OF BAND REJECTION (RELATIVE TO PASS BAND)</u>		ATTENUATION 110 TO 130 MHz		20		dB
		PEAK SIDE LOBE LEVELS			-50	dB
		FINAL ATTENUATION AND SPURIOUS OUTPUTS		50		dB
5) <u>RIPPLE</u>		THROUGHOUT BAND			1.5	dB
C2B						
<u>SUBGROUP A2 AT -35°C</u>						
1) <u>CENTRE FREQUENCY</u>		INPUT LEVEL + 10 dBm		115	125	MHz
2) <u>PASS BANDWIDTH</u>		3 dB POINTS		9.5	10.5	MHz
3) <u>INSERTION LOSS</u>		INPUT LEVEL + 10 dB		20.7	21.7	dB
4) <u>OUT OF BAND REJECTION (RELATIVE TO PASS BAND)</u>		ATTENUATION 110 TO 130 MHz		20		dB
		PEAK SIDE LOBE LEVELS			-50	dB
		FINAL ATTENUATION AND SPURIOUS OUTPUTS		50		dB
5) <u>RIPPLE</u>		THROUGHOUT BAND			1.5	dB

INSPECTION REQUIREMENTS

ALL TESTS SHALL BE CARRIED OUT AT $T_{AMB} = 25^{\circ}C \pm 5^{\circ}C$ UNLESS OTHERWISE SPECIFIED.

EXAMINATION OR TEST	REFERENCE N° 9450	CONDITIONS OF TEST	SYM.	LIMITS		UNITS
				MIN	MAX	
<u>C3</u> <u>ENDURANCE</u>		TEMPERATURE + 80°C 2000 HOURS. NON-OPERATING.				
<u>C4</u> <u>POST TEST END POINTS FOR C1 AND C3</u>		INCLUDES ALL TESTS IN SUBGROUP A2 (AT ROOM TEMPERATURE)				
1. <u>CENTRE FREQUENCY</u>		INPUT LEVEL +10 dBm		115	125	KHz
2. <u>PASS BANDWIDTH</u>		3 dB POINTS		9.5	10.5	KHz
3. <u>INSERTION LOSS</u>		INPUT LEVEL +10 dB		20.7	21.7	dB
4. <u>OUT OF BAND REJECTION (RELATIVE TO PASS BAND)</u>		ATTENUATION 110 TO 130 MHz PEAK SIDE LOBE LEVELS FINAL ATTENUATION AND SPURIOUS OUTPUTS		20	-50	dB
5. <u>RIPPLE</u>		THROUGHOUT BAND		50	1.5	dB
<u>C5</u> <u>CTR INFORMATION</u>		ATTRIBUTES INFORMATION FROM SUBGROUPS C1 AND C3				
<u>D1(a)</u> <u>VIBRATION (SWEEP FREQUENCY)</u>	1.2.6.8.1.	<u>GROUP D.</u> FREQUENCY RANGE 10 Hz TO 200 ACCELERATION 98 m/s ² DURATION - 2 HOURS IN EACH OF 3 MUTUALLY PERPENDICULAR AXES.				
<u>D3</u> <u>RESISTANCE TO SOLDER HEAT (D)</u>	1.2.6.16.2 (BS 2011 TEST T)	265°C - 10 SECONDS				
<u>D4</u> <u>ENDURANCE</u>		TEMPERATURE + 80 8000 HOURS. NON-OPERATING.				

INSPECTION REQUIREMENTS

ALL TESTS SHALL BE CARRIED OUT AT $T_{AMB} = 25^{\circ}C \pm 5^{\circ}C$ UNLESS OTHERWISE SPECIFIED.

EXAMINATION OR TEST	REFERENCE N ^o 9450	CONDITIONS OF TEST	SYM.	LIMITS		UNITS
				MIN	MAX	
<p>D5</p> <p><u>POST TEST END</u></p> <p><u>POINTS FOR</u></p> <p><u>D3, D4</u></p> <p>1) <u>CENTRE</u> <u>FREQUENCY</u></p> <p>2) <u>PASS</u> <u>BANDWIDTH</u></p> <p>3) <u>INSERTION</u> <u>LOSS</u></p> <p>4) <u>OUT OF BAND</u> <u>REJECTION (RELATIVE</u> <u>TO PASS BAND)</u></p> <p>5) <u>RIPPLE</u></p>		<p>INCLUDES ALL TESTS FROM SUBGROUP A2 (ROOM TEMPERATURE)</p> <p>INPUT LEVEL +10 dBm</p> <p>3 dB POINTS</p> <p>INPUT LEVEL +10 dB</p> <p>ATTENUATION 110 TO 130 KHz</p> <p>PEAK SIDE LOBE LEVELS</p> <p>FINAL ATTENUATION AND SPURIOUS OUTPUTS</p> <p>THROUGHOUT BAND</p>		<p>115</p> <p>9.5</p> <p>20.7</p> <p>20</p> <p>50</p>	<p>125</p> <p>10.5</p> <p>21.7</p> <p>-50</p>	<p>MHz</p> <p>MHz</p> <p>dB</p> <p>dB</p> <p>dB</p> <p>dB</p>
<p>- 6</p> <p><u>CTR INFORMATION</u></p>		<p>ATTRIBUTE'S INFORMATION FROM SUBGROUPS D3, D4.</p>				

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TITLE DRILLING AND SAWING OF QUARTZ AND ALUMINA SUBSTRATES
FOR SAW APPLICATIONS.

INDEX

- 1) Index
- 2) Flowchart
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- 5) Sawing

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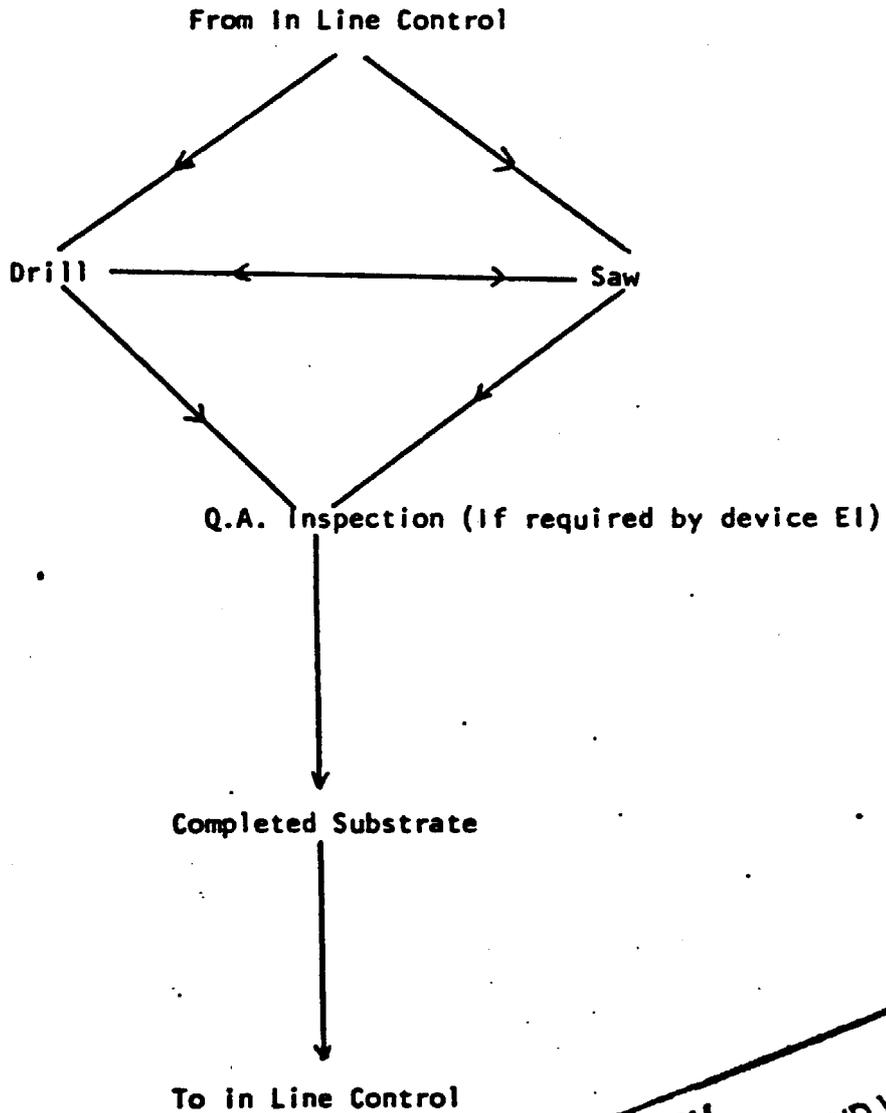
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TITLE DRILLING AND SAWING OF QUARTZ AND ALUMINA SUBSTRATES
FOR SAW APPLICATIONS
PARTS, MATERIALS, CHEMICALS, EQUIPMENT

1. Parts:

Alumina substrates as supplied. Nominally 4in x 2in or smaller.
 quartz substrates, size dependant upon usage.

2. Materials:

Glass blocks
 Carbon blocks
 Alumina plates

3. Chemicals:

Bees wax A piezon Wax W.
 De khortinski wax
 Methylated spirits
 Trichloroethylene
 Chlorothene
 Acetone
 'Virtol' cutting oil

4. Equipment:

Small bench drills: Meddings MB10 with research instruments
 DM50 positioning table.
 and: Micromecannica with uncalibrated positioning
 table.
 Diamond Saw, Semitron 2000
 Diamond saw blades
 Diamond Tube drills
 Solid shank diamond drills
 Mondo vero check optical measuring system
 Hotplate
 Coldplate
 Scalpels
 Wash bottle

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ENGINEERING INSTRUCTIONS

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TITLE DRILLING AND SAWING OF QUARTZ AND ALUMINA SUBSTRATES
FOR SAW APPLICATIONS
SAWING

Alumina substrates may be sawn individually or in stacks, the number in the stack being decided by the number of substrates needed, up to a maximum allowed by the depth of cut of the saw blade.
 Quartz substrates are sawn individually.

A. To Saw Singly

1. The substrate is waxed to a carbon block using any of the waxes mentioned. (For quartz substrate see device E1)
2. The substrate may be cut to the size required by the use of cutting marks on the substrate itself, or by using the optical alignment system and dial gauge indicator (or digital readout system) on the saw. (See relevant cutting diagram ref: device E1)
3. The sawn substrate is removed from its mount by melting the wax and is then cleaned in a suitable solvent. (See device E1)

B. To Saw Stacked

1. The substrates are scribed and snapped from the nominal 4in x 2in plates to a suitable size for mounting on to the blocks and to be slightly larger than the required final size.
2. They are stacked using any wax mentioned and aligned in the steel corne jig.
3. The stack is then mounted onto a block or blocks suitable for use on the saw.
4. They are then cut using the instruments on the saw to measure the correct size of substrate.
5. The substrates are separated by melting the wax and cleaned in a suitable solvent.

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