NASA CR-132934

COLLINS

N74-17932

(NASA-CR-132934) BROADBAND POWER
AMPLIFIER TUBE: KLYSTRON TUBE 5K70SK-WBT
AND STEP TUNER VA-1470S Final Report
(Collins Radio Co.) ~~240~~ 218 p HC $14.00 CSCL 09A G3/09

Unclas
31779

FINAL REPORT

BROADBAND POWER AMPLIFIER TUBE

Klystron Tube 5K70SK-WBT
and Step Tuner VA-1470S

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Dallas, Texas

January 1974
Final Report Type III

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. 1	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle BROAD BAND POWER AMPLIFIER TUBE AND REMOTELY CONTROLLED STEP TUNER (CHANNEL SELECTOR)		5. Report Date 7 JANUARY 1974
		6. Performing Organization Code
7. Author(s) H. R. COX and J. O. JOHNSON		8. Performing Organization Report No.
9. Performing Organization Name and Address COLLINS RADIO COMPANY DALLAS, TEXAS		10. Work Unit No.
		11. Contract or Grant No. NAS 5-20375
		13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address GODDARD SPACE FLIGHT CENTER GREENBELT, MARYLAND 20771		14. Sponsoring Agency Code
15. Supplementary Notes PREPARED IN COOPERATION WITH VARIAN ASSOCIATES, PALO ALTO, CALIFORNIA 94304		

16. Abstract

This report covers the design concept, the fabrication, and the acceptance testing of a wide band Klystron tube and remotely controlled step tuner for channel selection. The equipment was developed for the modification of an existing 20 KW Power Amplifier System which was provided to the contractor as GFE. The replacement Klystron covers a total frequency range of 2025 to 2120 MHz and is tuneable to six (6) each channel with a band width of 22 MHz or greater per channel. A 5MHz overlap is provided between channels. Channels are selected at the control panel located in the front of the Klystron magnet or from one of three (3) remote control stations connected in parallel with the step tuner. Also provided as part of the contract was one (1) each heat exchanger similar to the Trane Company heat exchanger provided with the initial power amplifier under the description UD-40. Included in this final report are the results of acceptance tests conducted at the vendor's plant and of the integrated system tests conducted at Collins Radio Company in Dallas.

17. Key Words (Selected by Author(s)) Klystron Tube 5K-70SK-WBT; Step Tune VA 1470S		18. Distribution Statement As stated in Article III of Contract NAS5-20375	
19. Security Classif. (of this report) None	20. Security Classif. (of this page) None	21. No. of Pages	22. Price* N/A

*For sale by the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

Figure 2. Technical Report Standard Title Page

PREFACE

1. OBJECTIVE

To develop a Klystron tube to replace the existing Varian 5K70SG Klystron tube presently in use in the Unified S-Band Power Amplifier System. The replacement equipment will:

a. Utilize as much of the existing power amplifier equipment as possible with minimum modification to the power supply, the power amplifier cabinet equipment and the heat exchanger.

b. Extend the frequency range of the power amplifier from 2090-2120 MHz to a total range of 2025 to 2120 MHz.

c. The tube will be tuneable over six (6) channels with a bandwidth of at least 22 MHz per channel with a 5 MHz overlap between channels.

d. Equipment must provide for selection of the six (6) channels from a remote location by use of a step tuner (channel selector). The step tuner must be capable of remote control from on one of three (3) remote control panels and must also be capable of interface with a computer.

2. SCOPE

a. To build the tube and tuner referenced in the above objectives.

b. To build a replacement heat exchanger as nearly as possible like the UD-40 unit provided with the initial equipment.

c. To provide necessary drawing and a modification to the existing manual to make possible the reprocurement of this equipment from a vendor normally engaged in the production of equipment of this type.

d. To provide necessary instruction for the installation of the equipment in the existing Power Amplifier and to provide an ATP for the modified system.

3. CONCLUSIONS

That the tube and tuner as now designed are capable of operating within the parameters of the specification when properly tuned. That the modification to the existing equipment required to accommodate the 5K70SK-WBT Klystron and the VA-1470A tuner are minimal and can be performed at the field location of the equipment providing qualified installation personnel are supplied with an installation kit and proper instruction material.

4. RECOMMENDATIONS FOR FUTURE BUILD

a. That the band pass ripple as outlined in Paragraph 3.2.3 of specification 5-813-P-7 be relaxed to read as follows "The bandpass ripple shall not exceed 1.6 db or $\pm$0.8 db of the nominal output power. The Varian Associates state that they are not positive that they can consistently produce a tube that meets the 1 db ripple specification.

b. That the three remote control panels be either rebuilt in entirety or be modified at a factory location and be provided as part of the installation kit rather than attempt field modification of the panels.

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ATTACHMENTS

I. INTRODUCTION

Contract NAS5-20375 for the broadband power amplifier tube with remote channel selector, GFE modification and software items in accordance with GSFC specification S-813-P-7 and the above referenced contract was awarded to Collins Radio Company on 21 September 1972. The PA system, as modified to accommodate certain new items of equipment along with the new equipment was delivered to GSFC in late December 1973. Delivery of the final software is scheduled to be completed by 1 February 1974.

II. CHRONOLOGICAL EVENTS

(1) 21 September 1972 - Contract Award

(2) 12 October 1972 - Subcontract for Tube and Tuner Awarded to Varian.

(3) 7 December 1972 - Design Approach Review at GSFC

(4) 31 May 1973 - Critical Design Review at GSFC

(5) 20-22 June 1973 - 1st Vendor Acceptance Tests

(6) 26-27 July 1973 - 2nd Vendor Acceptance Tests

(7) 10 August 1973 - Tube and Tuner Delivered to Collins

(8) 28-31 August 1973 - 1st Acceptance Test Conducted at Collins

(9) 20 September 1973 - Lead Screw Failure - Tube Returned to Varian for Rebuild.

(10) 29 October 1973 - Rebuilt and Retested Tube - Returned to Collins.

(11) 7 November 1973 - 2nd Acceptance Test Conducted at Collins.

(12) 4 December 1973 - All Tests, Reruns and Repeatability Checkout Complete.

(13) 20 December 1973 - Tube, Tuner and Heat Exchange Shipped.

III. EQUIPMENT DEVELOPMENT, FABRICATION & TEST

(a) The Broadband Tube 5K70SK-WBT.

On 12 October 1972, Collins issued a fixed price subcontract to Varian Associates of Palo Alto, California for the broadband tube and remotely controlled channel selector. At the design approach meeting held at Goddard on 7 December 1972, Mr. Earl McCune of Varian presented the overall design approach for the Klystron tube outlining the modifications that were required to gain the additional tuning range. The discussion related primarily to the use of the sliding short within the cavity for tuning in place of the deformable wall tuning as was used in the 5K70SG tube. Relative reliability of the sliding short vs. the use of a capacity probe as a tuning method were discussed. As part of the presentation, cold test data on the tuning range and R/Q ratio of the modified cavities was presented. (For additional details, see the minutes of the Design Approach Meeting submitted on 2 January 1973).

On 31 May 1973, the Critical Design Review Meeting was conducted at Goddard Space Flight Center. At this meeting, preliminary test data was presented. It was pointed out that the tube was constructed using the same titamium evaporative Getter, which was used as a standard on the 5K70SG Klystrons. It was suggested that the customer considered, in subsequent tubes, the use of a VAC-ION Pump, which would allow monitor of tube gas pressure during tube storage. Factory acceptance tests of the tube were attempted at the Varian plant during the period 20-22 June. The tests were discontinued due to a mechanical failure in the tuner. Successful factory tests of the tube were completed at Varian during the period 27-31 July. The tube was delivered to Collins Dallas in mid-August and was integrated into the PA System with no major problems or misfits.

During the period 27 August to 1 September, acceptance tests were conducted at the Collins Dallas plant and were witnessed by the technical officer from GSFC. In general, the test results were excellent, however, late in the test, it was noted that a mechanical stoppage had developed in the first cavity. This stoppage was corrected by removing and replacing the lead screw and running a tap through the tuning slug. Later a more serious stoppage occurred in cavity three, and the galled and jammed lead screw was removed with great difficulty. At this point, the tube manufacturer resolved to change the material in the lead screw from stainless steel to phosphor bronze. After the phosphor bronze lead screws were installed it was discovered that cavity three (3) was microphonic which was the result of damage to the contact wires on the sliding short when removing the jammed lead screw. At this point, the tube was returned to Varian for rebuild. The tube was fully retested at Varian after rebuild and was returned to Dallas on 29 October. Retests of the tube in the system conducted for GSFC during the period 5 to 9 November, were satisfactory as long as the isolator in the drive chain was placed directly adjacent to the input cavity of the tube. This arrangement rendered the drive reflected power meter inoperative, which was not acceptable to the customer. During the period 14 November to 27 November, extensive investigation was made into the effect on the bandpass of auto tuning of various cavities. It was discovered that all channels could be properly tuned to the bandpass ripple specification and was repeatable if the input VSWR could be reduced to 1.07:1. This VSWR requirement was attained by using an improved directional coupler in the drive power chain and a ROTA-STUB tuner next to the input cavity. Following the integration of these items into the drive chain, the tube proved to be specification compliant in all tests conducted.

(b) The Step Tuner (Remotely Controlled Channel Selector)

The initial operational concept for the step tuner was based on analogue system. At the time of the design approach meeting (7 December 1972), the possibility of the use of a digital system was under investigation. Further study indicated that the use of a digital system would provide the most accurate and exact control of the sliding shorts in the tuning cavities. Varian, therefore, issued a subcontract to Summit Engineering in Bozeman, Montana for the major components of a digital control system. In this agreement, Summit Engineering would provide all the logic cards, the stepping motor and the control panel while Varian would proceed with the design and build of the step tuner housing, the mechanical readouts and the drive linkage between the stepping motors and the tuning lead screws in the tube.

The step-tuner logic components were delivered to Varian by Summit in May 1973 and failed to pass incoming inspection by Varian in-plant DCASO. The problems were all related to failure to meet the provisions of specification NHB-5300.4(A) in regard to electrical soldered connections. Correction and improvement of solder connections continued both at the Varian plant and at Collins up until final acceptance of the unit.

During the attempted vendor acceptance tests of 22 June, the tuner failed to operate properly, and it was discovered that it was necessary to change out the low speed type Veeder Root Counters for a high speed type that would withstand the 700 RPM required.

In July, an improved power supply for the step tuner was provided and installed to further improve the system.

In early September, Collins began to experience problems with the step tuner and failures in the power transistors on the logic board. A Summit engineer visited the Collins Dallas plant on 14 September, and the following changes were made in the tuner circuits.

(1) The 3 Amp TIP32A power transistors on the main logic were replaced with 8 Amp MOT-MJ6040 power transistors.

(2) A 1/4 Amp fuse was placed in all three remote panels and in the main unit to protect the transistors against overloads resulting from possible shorting of the type #387 indicator lamps in the control unit.

(3) A diode was installed between switch and the light indicator at each of the six switches on the three remote panels to eliminate reverse flows that might allow the panel to remain operational even with an open fuse.

In order to save wear and tear on the lead screws in the tuning cavities, the tuning cycle period was extended by about 20% by adjustments of the control pot on the driver board. Shortly after extention of the tuning cycle period, transistors TIP31A and TIP32A on the Summit driver board #213-801-00 started to fail. It was calculated that the reduction of the stepping motor speed may have changed the motor torque, which, in turn caused an excessive power drain across several of the power transistors. Two steps were taken which corrected this problem.

(1) A heat sink material was applied between the power transistor and the mounting bracket.

(2) The value of the following four (4) resistors on the driver board were reduced, thereby placing the power transistors in a saturation mode which reduced the power drain

R5 From 8.2K to 3.3K
R8 From 10K to 3.3K
R11 From 8.2K to 3.3K
R14 From 22K to 3.3K

Following these final modifications and the removal of all components damaged prior to the resistor change, the tuner was operated over at least 1000 tuning cycles with no further problems.

(c) Redesign of the Control Panel

The redesign of the control panel to accomodate the six channel selector switches and the tune cycle lamp on the same sized panel presented no problem. It was found that nearly all components on the old panels were reuseable. The input drive power meter was replaced; however the old meter was operational and could have been used by adding a meter face with a different scale.

A terminal board on the rear of the control panel provided a conventient computer interface point if and when required.

(d) Heat Exchanger.

The Trane Co, builders of the initial heat exchanger, did not wish to build a single UP-40 type heat exchanger, and Collins failed to reach an agreement regarding purchase of the Trane drawing. Collins, therefore, performed an in-house build of the heat exchanger based on the information available in the manual, limited drawing left over from the Apollo contract, available spare parts lists plus sketches, pictures and measurements from an actual unit at USB Station location. The Collins built unit is basically identical with the former unit and nearly all GSFC spares, that may be on hand, including the coil, can be used as replacements on the Collins built unit. Several components used in the initial build are no longer available, however, for the most part, the substitutes selected can be replaced with spares presently in stock.

One exception to the above is the use of an improved direct drive coil cooling fan to replace the belt driven fan used for air circulation on the Trane unit.

The cooling capacity of the Collins unit is between 10% to 20% improved over that of the UD-40 built by Trane.

(e) Modifications to the GFE Equipment, modifications to the PA System were relatively simple and involved a minimum of mechanical and electrical changes and additions. The drawing provided, as a separate item of this contract, covers the changes in detail as do the installation instructions included as part of this report; therefore, further amplification is considered unnecessary.

(f) System Tests

The acceptance test procedure and the results of the factory tests at Varian and the systems tests at Collins are included as part of this report.

IV. CONCLUSION

The broadband Klystron tube, the step tuner and the modification to the GFE power amplifier do not represent new technology in that all methods used in obtaining the boardband capacity of the tube by use of a sliding short and control of the channel selection by the digital method had been used before. The logic circuits provided by Summit Engineering Company and the drive circuit engineering by Collins were modifications of existing equipment using, for the most part, standard off the shelf items. The technique as used in this application was new and proved satisfactory in spite of minor redesign and the resultant delays. As an example sliding short method of tuning proved successful after the problem of the galling and subsequent jamming of the stainless steel lead screw was overcome by the use of a screw made of phosphor bronze. The digital step time proved to be entirely satisfactory after minor component changes were made. Overall modification and change to the equipment was relatively minor considering the magnitude of the project.

After the final clean-up of the system, when all components on the step tuner drive boards were examined and replaced as warranted, the system was operated over approximately 1000 tuning cycles without failure. During these final tests, the system was fully repeatable. It is estimated that the tube has been tuned between 1000 and 1500 times since the phosphor bronze lead screw were installed. In view of the above, it appears that the system as delivered is highly reliable and should give years of trouble free operation.

FINAL TEST REPORT

CONTRACT NAS5-20375

FINAL TEST REPORT

FOR

UNIFIED S-BAND POWER AMPLIFIER SYSTEM

CONTRACT NAS5-20375

PREPARED IN ACCORDANCE WITH

GSFC SPECIFICATIONS

S-250-P-1C (TYPE 1)

PREPARED BY: H. R. Cox
H. R. COX

APPROVED BY: J. O. Johnson
J. O. JOHNSON

COLLINS RADIO COMPANY

DALLAS, TEXAS

FINAL TEST REPORT FOR

UNIFIED S-BAND POWER AMPLIFIER SYSTEM

1.0 GENERAL

The Modified Unified S-Band Power Amplifier System provided by Collins Radio in accordance with Contract NAS5-20375 was tested to ensure compliance with the requirements of GSFC specification S-813-P-7. Tests were performed at the facility of the tube/tuner vendor to prove operation of this assembly. Additional tests were then performed at the Collins facility with the tube/tuner installed in the modified GFE amplifier system to prove compatibility.

The tests performed by Varian and Collins, the difficulties experienced in obtaining acceptable results, and the corrections made to improve performance are discussed in the following paragraphs. The results of tests performed by Collins and Varian are included as a part of this report, and they may be used to verify the system operates within acceptable limits. The difficulties experienced during some of the testing is discussed and corrections or modifications made to improve performance are noted.

2.0 VARIAN ACCEPTANCE TESTS

On July 26, 1973, tests were performed at Varian to prove operation of the tube/tuner combination. These tests were performed in accordance with Varian Publication No. 87-800-215. These tests verified operation in the laboratory set-up in the following parameters:

A. Hydrostatic Pressure

B. Body Coolant Pressure Drop

C. Collector Coolant Pressure Drop

D. Heater Current

E. Tuner Torque

F. Cathode Current

G. Emission

H. Collector Dissipation

I. Power Output

J. Band Width

K. Gain

L. Efficiency

M. Warm-up Time

N. Body Current

O. Bandpass Amplitude Ripple

P. Linearity

Q. Tuner Operation

U. Spurious Outputs

3.0 KLYSTRON CAVITY TUNING FAILURE

After completion of the tests at Varian, the tube was shipped to Collins and installed in the GFE amplifier system. While attempting to tune the amplifier, Cavity A bound up and could not be tuned. With approval from Varian, the tuning screw was removed, a clearing tap was run through the nut, and a new screw was installed. This cleared the problem of tuning on this Cavity.

Further tuning of the tube was accomplished during the next several days and then the tube bound on Cavity C. At this time, it was decided to return the tube to Varian for repair.

When Varian received the tube, an extensive review was performed to determine the cause of failure. It was determined the tuning screws should be replaced with ones made of phosphor bronze to eliminate galling with the stainless steel nut.

4.0 TUNER LIGHT DRIVER FAILURE

During the initial testing of the amplifier system, several failures occurred in the light driver section of the main logic board. It was determined that excessive current drain caused by shorted indicator bulbs was the reason the transistors were shorting. A modification of this circuit which prevents the excessive current drain was installed in the tuner. This modification consisted of fusing the indicator return line and installing diodes in the power side of the indicators to eliminate return paths. In addition, to prevent any possible overload during indicator warm-up, the driver transistors, Q11 - Q16 and Q23 on drawing D12-213-801-02 were changed from TIP 31A to MOT-MJE6040. These transistors have a current rating of 8 amps, which is far in excess of any normal requirement.

5.0 REPEAT OF VARIAN ACCEPTANCE TESTS

To ensure that the Klystron tube after repair at Varian would still meet the specification requirements, Collins requested that all bandpass measurements be repeated. These tests were performed on October 23, 1973 and indicate the tube met all requirements. The tuner had not been shipped with the tube, and all tuning was performed manually.

6.0 TUNER STEP TUNER DRIVER FAILURE

After return of the tube from Varian, it was decided to reduce the speed of the driver motors as a means of prolonging the tuning life of the tube. Means are available on the driver board to accomplish this, and the speed of all motors was reduced approximately 20 %. After this change, failures began to occur in the driver board. The tuner manufacturer, Summit Engineering, determined the motor driver transistors, Q4, Q5, Q9, Q10 on boards A8 - A12, were running slightly out of saturation, due to the motor speed change. This caused the power dissipation across the transistors to increase, thereby causing failures due to overheating. Resistors R5, R8, R11 and R14 were reduced in value, causing the driver transistors to be driven into saturation. All boards were then carefully checked by Summit Engineering to ensure they were operating correctly.

7.0 COMPLETION OF SYSTEMS TESTS AT COLLINS

With the tube and tuner operational, Collins completed the tests required to ensure compatibility with the GFE S-Band Amplifier System. The following tests were performed:

A: System Turn-On

B. Power Output

C. Band Width

D. Linearity

E. Spurious Outputs

F. Tuner Operation

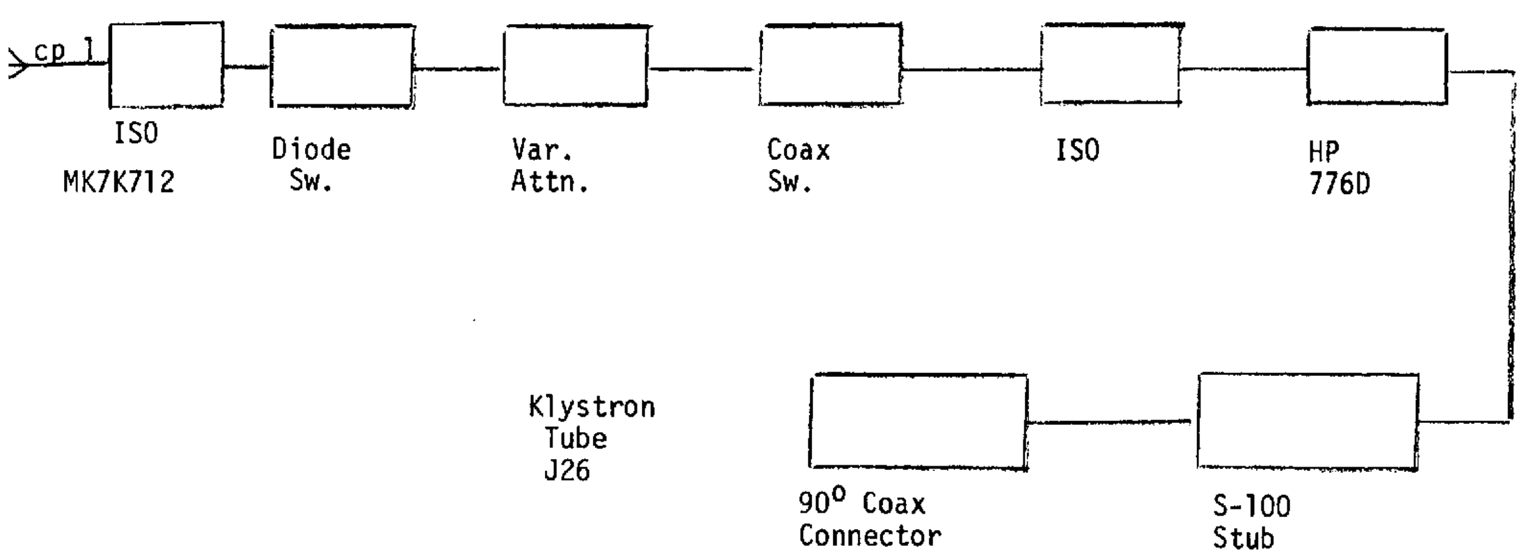
G. Repeatability of Tuning

On November 7, 1973, all remaining tests were completed with Mr. Kingman of GSFC as witness. These tests indicated that some channels were difficult to tune and that repeatability of tuning was unsatisfactory. Collins was requested to perform further testing to determine whether improvements could be made to ease the tuning and to improve the repeatability.

In an effort to maintain the system in its original configuration, Collins had been attempting to complete the tuning with the original coupler located next to the input to the Klystron tube. The isolator normally located at the input to the cabinet was placed next to the tube and tuning was again attempted. All channels were tuned within specification, and the ease of tuning was considerably improved. This solution was unsatisfactory to Mr. Kingman, however, since the capability of monitoring reflected input power would be lost.

Discussions with Mr. Goldfinger of Varian indicated that a maximum input line VSWR of 1.07:1 was necessary to ensure the results obtained at Varian could be repeated. With the coupler next to the tube, a VSWR of 1.42:1 was measured looking back into the line from the tube. With the isolator next to the tube, a VSWR of 1.22:1 was obtained. From these results, it was determined that in order to obtain a VSWR of 1.07:1, some means of tuning the input line would have to be employed.

A rotary stub tuner was selected to obtain the tuning since this would minimize congestion and would reduce the chance for accidental de-tuning of the stub. A Teledyne S-100 RODO Stub Tuner provided excellent results when the normal coupler was replaced with an HP 776 D Coupler. With the configuration depicted below, a VSWR of 1.07:1 was obtained looking from the tube back into the input line.



The proceedure used to obtain the required input VSWR is as follows:

A. Set up sweep generator to cover the total bandpass of 2020 MHZ to 2127 MHZ.

B. Calibrate the 8410A Network Analyzer in an open line configuration. This setting will be used to determine the improvement obtained by tuning of the line.

C. With the line connected as shown on Page 5, connect the 90° coax connector to the unknown port of the 8741A Relection Test Unit.

D. Tune the stub tuner for maximum return loss(minimum VSWR). This should be at least 33dB.

E. Connect the 90° coax connector to the Klystron being careful not to affect the tuning.

Using the above techniques, acceptable bandpass responses were obtained without the loss of the reflected input power reading. New tuning curves were obtained and repeatability was verified by Collins. The improvement in tuning permitted the repeatability requirements to be met. A slight bandpass tilt occurs on all channels and at each power level as a channel is tuned, recorded, then tuned off channel and back on. This tilt did not exceed 0.2dB in any case.

On November 30, 1973, further tests were performed to verify acceptable tuning and repeatability. The DCASO representative was requested to monitor the tests and verify performance. The tests were accomplished by recording a graph of the passband at 1 KW, tuning off-channel and then back to the channel, then re-recording the passband. The power output was then raised to the 20KW, and the recordings were repeated. Results of these tests indicate the tuning of all channels repeats within 0.2dB over the bandpass. The 20KW passband of channel 5 was just in specification on the first run and on the repeat test was 0.2dB out of specification. An earlier agreement with the customer assured Collins that tests would not be rejected due to this slight discrepancy.

Retuning of this channel would have brought it into specification, but it was not considered worthwhile to detain the DCASO representative.

After discussions with Mr. Tagler and Mr. Kingman of GSFC, Collins agreed to perform testing in addition to that required by CRC Proceedure 607-4319-001. This additional testing consisted of recording the passband response on all channels at power levels of 2KW and 10 KW. On December 3, 1973, the equipment was turned on, allowed to stabilize, and the passbands recorded at 2KW and 10KW on all channels. No adjustments were made to the equipment from the time tests were run on 11/30/73. All passbands were within specification. These results are indicative of what may be expected with day-to-day tuning of the equipment.

To maintain the equipment specification of a maximum input VSWR of 1.25:1, Collins has added an isolator to the input circuit. This isolator is a Microwave Associates MA7K712, which has an input VSWR specification of 1.2:1. This isolator was installed between CP1 and the diode switch in the klystron input circuit.

8.0 CONCLUSION

The equipment appears to meet all requirements of the specification as it is not configured. Modifications have been required in the amplifier cabinet to permit acceptable operation. These modifications have been implemented in the equipment under test and have been properly documented in the modification drawings.

All modifications required to correct the tuner malfunctions have been implemented, and the related drawings updated by Summit Engineering. Tuning operations in excess of the normal operating life of the tube/tuner have been performed during the long period of testing. It is felt that all basic design faults have been located and corrected.

Tuning of the Klystron tube appears normal and no further problems have been experienced since the phosphor bronze tuning screws were installed. As with the tuner, extensive operation during testing has proven the unit to be fully satisfactory.

Collins believes the system to be fully specification compliant. Test data as recorded at Varian and Collins during the numerous test phases is submitted as an indication of this compliance. It should be noted that the parameter <u>Gain</u> as recorded on the bandpass graphs is not a true indication of the tube gain. The input signal was inserted at CPI of the amplifier cabinet. The input circuit losses of the diode switch, isolator, coupler, coax switch and some attenuation in the variable attenuator must be considered when calculating the tube gain. The measurements made at Varian show that an actual tube gain in excess of 45dB is available on all channels and at all power levels.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

1.0 SCOPE

This procedure outlines tests to be performed to assure operation of the Unified S-Band Power Amplifier System after completion of the modification described in Procedure 607-4320-001. This modification was performed in accordance with GSFC specification S-813-P-7 as directed by Contract NAS5-20375.

The first portion of the tests is devoted to checking the GFE R-F enclosure, power supply cabinet, and motor generator equipment to assure they are operational and will support the later tests using the new 5K70SK-WBT klystron tube.

After the existing system has been proven, the 5K70SG tube will be replaced and the remote tuner installed per the modification procedure. The remaining portion of the tests will then be performed to prove system performance with the new configuration.

2.0 APPLICABLE DOCUMENTS

The following documents form part of this procedure:

GSFC Specification S-813-P-7

Varian Procedure No. 87-800-215

Collins Radio Specification 090-0046-257

Collins Radio Specification 090-0047-257

Technical Manual S-Band Klystron Power

Amplifier Subsystem Model 11-076

REV STATUS	REV																								
OF SHEETS	SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

CONTRACT NO. NAS5-20375	COLLINS RADIO COMPANY DALLAS, TEX NEWPORT BEACH, CALIF CEDAR RAPIDS, IA
PREP	MODIFICATION TEST PROCEDURE UNIFIED S-BAND POWER AMPLIFIER SYSTEM CONTRACT NAS5-20375
CHK	
APVD	SIZE A — CODE IDENT 13499 — DWG NO. 607-4319-001
	SCALE — SHEET 1 of 21

074-5225-050
NEXT ASSY: TYPE NO: ERO NEP REL REV

3.0 TEST EQUIPMENT REQUIRED

The following test equipment or equivalent is required to perform the system tests as described in this procedure:

Volt-Ohm-Meter Triplett

Clip-on Ammeter

Sweep Oscillator HP8690A/8692B

Microwave Amplifier Alfred Model 5020

Variable Attenuator NARDA 792FF

Coaxial Crystal Detector HP423A 2 each

Coaxial Feedthrough Termination HP10100A

Precision Attenuators 1, 2, 3 and 5 dB Weinschel

Fixed Attenuator 20 dB

Oscilloscope HP545A

Spectrum Analyzer HP8555

Power Meter HP432A

Signal Generator HP8614A

Directional Coupler NARDA 3043-10 2 each

X-Y Recorder Houston Instrument Model 2000

Counter HP5445L

Frequency Converter HP5254B

4.0 TEST CONDITIONS

All tests are to be performed under ambient conditions of temperature, humidity, and vibration. The system tests to be performed assume that individual unit tests have been completed.

5.0 PRELIMINARY TEST OF GFE EQUIPMENT

5.1 CIRCUIT BREAKER TEST

Step 1.

Open all equipment circuit breakers. Turn the filament and magnet supply autotransformer adjustments to minimum settings. ✓

Step 2.

Close the 440- and 208-volt ac primary supply lines to the equipment and verify phase voltages on the equipment panels. ✓

Step 3.

Close the dc control circuit breakers, PA SYSTEM OFF indicator should light, Record. ✓

5.2 HEAT EXCHANGER TEST

Step 1.

Close CB1 (control) and place the SAFE/OPERATE switch to OPERATE. Interlock lamps, Low Flow and Air Flow, should turn on when the REMOTE/LOCAL switch is placed in LOCAL. ✓

Step 2.

Close CB3, fan motor, and verify operation of fan after the 45±5-second time delay has elapsed. The air interlock lamp turns off at this time. Record.

NOTE: The liquid level interlock lamp should also be off. * 208 VOLTS HIGH. THIS CAUSED TIME TO DECREASE. HRC

38 sec.

Step 3.

Close pump circuit breaker CB2, and verify that the flow interlock lamp turns off at this time. ✓

Step 4.

Close CB4, heaters, and verify that the temperature remains within the limits of 30° C to 40° C after 30 minutes of operation without the Power Amplifier on. Record. * HEATERS DID NOT COME ON SINCE AMBIENT IS OVER 30°C. HRC ✓

Step 5.

Switch S6 LOCAL/REMOTE switch to REMOTE. ✓

5.3 CONTROL CIRCUITS

Step 1.

Operate each of the three PA SYSTEM ON switches. Check for correct functioning of the PA SYSTEM ON and BEAM VOLTAGE OFF lamps. Leave PA SYSTEM ON in ON position after testing third panel. ✓

Step 2.

Operate the INTLK LAMP TEST switches on each of three control panels and observe illumination of all interlock lamps. ✓

Step 3.

Close CAB BLOWERS circuit breakers, and verify that the air blowers in the power supply enclosure are functioning properly and that the CABINET AIR interlock lamps turn off on the FAULT LOCATION panels. ✓

Step 4.

Close the ENCLOSURE PWR SUP circuit breaker and verify that the green lights are lit in the Power Supply and RF Enclosure when the interlocked doors are opened. ✓

Step 5.

Open the door interlocks individually and verify that the CABINET DOORS interlock lamps turn on (two each on the Power Supply, and one each on the RF Enclosure). Record. ✓

5.4 COOLANT FLOW

Step 1.

Check that coolant flow is present in the RF Enclosure 45±5 seconds after the system ON switch is pressed, and that the heat exchanger lamp is off. ✓

Step 2.

Verify the following:

(a)	INLET PRESSURE:	60-80 PSI		80
(b)	OUTLET PRESSURE:	0-10 PSI		0
(c)	COLL FLOW	22 GPM		22
(d)	RF DUMMY LOAD:	3.78 GPM		3.78
(e)	BODY FLOW:	1.48 GPM	Record.	1.45

Step 3.

Check that coolant flow is present in the klystron magnet by switching off the heat exchanger momentarily and noting that the COOLANT MAG underflow lamp turns on. ✓

Step 4.

Repeat 5.4 (3) for BODY COOLANT. ✓

Step 5.

Repeat 5.4 (3) for COLL COOLANT. ✓

Step 6.

Repeat 5.4. (3) for RF LD coolant. ✓

Step 7.

Repeat 5.4 (3) for ISO coolant. Record. ✓

5.5 Klystron Filament Supply

Step 1.

Close AC REG and KLY FIL circuit breakers in the Power Supply cabinet. Verify that the KLY FILAMENT Air interlock lamp turns off, and that the KLY FILAMENT TD is lighted. At the conclusion of the 5-minute timing sequence, verify that the KLY FILAMENT TD lamp turns off. Record. ✓

Step 2.

After the time delay has elapsed, set the KLY FIL ADJUST in the RF Enclosure to provide 7.5 volts. Note the value of filament current at which the KLY FILAMENT U/C lamp turns off. Record.

6.0 VOLTS
9.5 AMPS

5.6 Klystron Magnet Power Supply

Step 1.

Move the meter relay setting on DC AMPS to its minimum position. ✓

Step 2.

Turn on the magnet supply AC POWER circuit breaker. ✓

Step 3.

Set the magnet supply ADJUST to the klystron tube for approximately 18 amps. After klystron tube is operational magnet current should be adjusted for minimum body current. This should be performed with power output in excess of 10KW. ✓

Step 4.

Close RF PROTECTION circuit breaker. Move the meter relay setting on the DC AMPS meter upscale until it engages the scale pointer, where the MAG U/C fault lamp turns on. ✓

Step 5.

Set the contact pointer to 15 amps, and release the pointer by pressing the interlock reset switch. ✓

5.7 METER RELAY

Step 1.

Turn the contact pointer on the BEAM VOLTAGE meter counterclockwise. Note that the BEAM HV-OV interlock lamp turns on. Return pointer to 22 kv and reset. ✓

Step 2.

Repeat 5.7 (1) for the BEAM CURRENT meter. Check that the BEAM HV-OC lamp turns on. Set the pointer at 3 amps and reset. ✓

Step 3.

Repeat 5.7 (1) for the BODY CURRENT meter. Check that the BODY OC lamp turns on. Set the pointer to 75 ma and reset. ✓

Step 4.

Repeat 5.7 (1) for the FWD RF OUTPUT PWR meter. Check that the FWD RF OUT PWR lamp turns on. Set the pointer to 22 kw and reset. ✓

Step 5.

Repeat 5.7 (1) for the REFL RF OUTPUT PWR meter. Check that the REFL RF OUT PWR lamp turns on. Set the pointer at 0.5 kw and reset. ✓

5.8 RF DRIVE ATTENUATOR

Step 1.

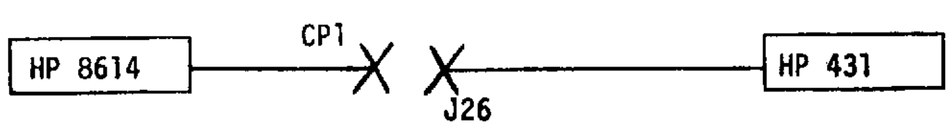
With the test configuration as shown in Figure 1.0. establish a reference point on the HP 431 power meter with approximately 30 dB of measurement capabilities. Inject the rf signal into CP1 of the rf cabinet. At the rf drive cable connected to the klystron, J26, measure the insertion loss of the drive input and record the data. >30dB ✓

Step 2.

Verify operation of the drive attenuator by operating the RF DRIVE RAISE/LOWER switch. Record. ✓

Step 3.

Turn on the ac POWER to the ARC DETECTOR AND REFLECTED POWER INTERLOCK PANEL. Depress ARC DETECTOR TEST and note at least 20 dB of isolation in the rf drive line. Reset and repeat with REFLECTED POWER TEST. Reset again and repeat with ARC DETECTOR TEST switch on the control panel. Record. ✓



F = 2100 MHz

Figure 1.0. RF Drive Measurement Test

5.9 MOTOR-GENERATOR

Step 1.

Check that the BEAM VOLT LOWERING interlock lamps are on until the following action is taken:

(a) Close the INPUT and OUTPUT CIRCUIT BREAKERS on the MG Set Controller. ✓

(b) Set the GENERATOR FIELD rheostat to its extreme counterclockwise position. ✓

(c) Set AUTOMATIC/MANUAL switch on the MG Set Controller to AUTOMATIC. ✓

Step 2.

Close the MG CONTROL circuit breaker on the Power Supply cabinet. Press the interlock reset and the MG will start. ✓

Step 3.

Adjust the MOTOR FIELD rheostat for minimum line current. ✓

Step 4.

The BEAM VOLT LOWERING lamp is off. ✓

Step 5.

Operate the PA SYSTEM ON/OFF switch and verify that the MG set turns on and off. Record. ✓

Step 6.

Close the MG OUTPUT CIRCUIT BREAKER and place MOTOR GEN. DISABLE switch inside the power supply cabinet to OFF. Verify that the BEAM VOLT LOWERING lamp turns on. Return to ON position. Record. ✓

5.10 Beam Voltage Ready

Step 1.

Depress INTLK LAMP TEST. All interlock lamps turn on. ✓

Step 2.

Turn BEAM VOLTAGE SAFETY SWITCHES to RUN position, and BEAM VOLTAGE READY light turns on. ✓

Step 3.

Depress BEAM VOLTAGE OFF switch, and READY light shall turn off until released. Record. ✓

5.11 Battleshort

Step 1.

Turn the system on. All interlocks will operate and their lamps turn off. Cause an interlock fault and the READY lamp will turn off. ✓

Step 2.

Turn on BATTLESHORT switch and READY lamp will turn on. ✓

Step 3.

BATTLESHORT lamps will flash at a rate of approximately 30 per minute. ✓

Step 4.

Turn off BATTLESHORT and return to normal operating condition. Record. ✓

5.12 Waveguide Switch

Check that the RF LOAD selector switch operates only when the BEAM VOLTAGE is OFF. Record. ✓

CAUTION

Remove all rf drive to klystron before this test.

5.13 Automatic Runup

Step 1.

Set HV AUTO RUNUP meter pointer inside POWER SUPPLY to 15 KV, and switch MOTOR GEN. CONTROL TO AUTO mode. Switch Dummy local/antenna indicator to Dummy load. ✓

Step 2.

Turn BEAM VOLTAGE to ON and check that voltage comes up to the meter setting at which time it will stop. ✓

Step 3.

Turn BEAM VOLTAGE to OFF and set the meter pointer to 21 kv, and switch MOTOR GEN. CONTROL to MANUAL mode. ✓

5.14

With the following procedure, verify that the klystron has been previously tuned to a broadband condition. Record. (See Figure 2.0. for test configuration.) ✓

Step 1.

Inject the sweep oscillator signal into the RF enclosure connector (CP1) and observe that the 1-dB bandwidth is 10 mc at 2103 mc for the following power levels: 5, 10, 15, and 20 kw. ✓

Step 2.

Switch the sweep generator to the cw mode of operation at 2103 mc. Operate the power amplifier at ~~20~~ 15 HRC kw, and calculate the following:

$$\text{Efficiency} = \frac{\text{Power Output (watts)}}{\text{Beam Current X Beam Voltage}} \text{ X100\%} \quad \frac{15 \times 10^3}{20 \times 10^3 \times 2} = 37.5\%$$

$$\text{Gain} = 10 \log \frac{\text{Power Output (watts)}}{\text{Power Input (watts)}} = 10 \log \frac{15 \times 10^3}{.200} \qquad 48.7 \text{ dB}$$

$$= 10 \log 75 \times 10^3$$

$$= 48.7 \text{ dB}$$

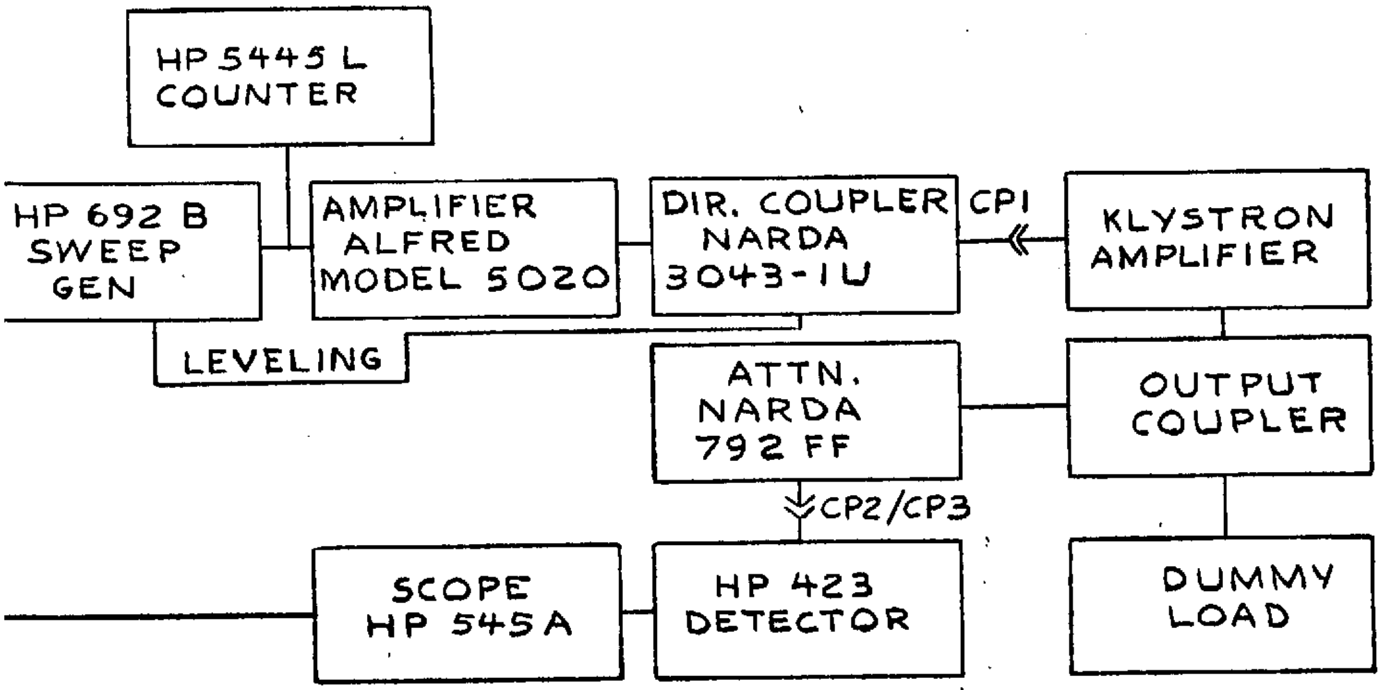


Figure 2.0. Broadband Test Configuration

5.15 RF Output Power Calibration

Step 1.

Using the calorimetric method, verify the FWD RF OUTPUT POWER meters. Insert the two centigrade thermometers in the rf dummy load wells. (Place a small quantity of water in each of the wells for heat transfer.) ✓

Step 2.

Turn the PA SYSTEM ON; using the previous test set-up only, operate in cw mode at approximately 2103 mc. ✓

Step 3.

RAISE the BEAM voltage until 2.0 kw is obtained. ✓

Step 4.

Read the flow rate through the dummy load and observe that the inlet and outlet temperatures have had sufficient time to stabilize. ✓

Step 5.

Calculate the power output from the following equation:

Power in kw = 0.265 times dummy load (flow gpm) times outlet temperature, minus inlet temperature in degrees centigrade or temperature diff. Record. 20KW

NOTE

Constant changes with glycol content, see Instruction book for table of constants.

Power (KW) = 0.265 X Dummy Load (Flow gpm) X Outlet Temperature - Inlet Temperature ($^{\circ}$C) (or temperature difference) N/A

5.16 Linearity

Step 1.

Set up test equipment as shown in Figure 3.0. Adjust the output of two signal generators such that the power output for each frequency is 2.0 kw at 2101 MHz and 2105 MHz. ✓

Step 2.

Measure the third order intermodulation products on the spectrum analyzer. The third order intermodulation products should be at least 30 dB below the 2.0 kw level. Record. >30dB

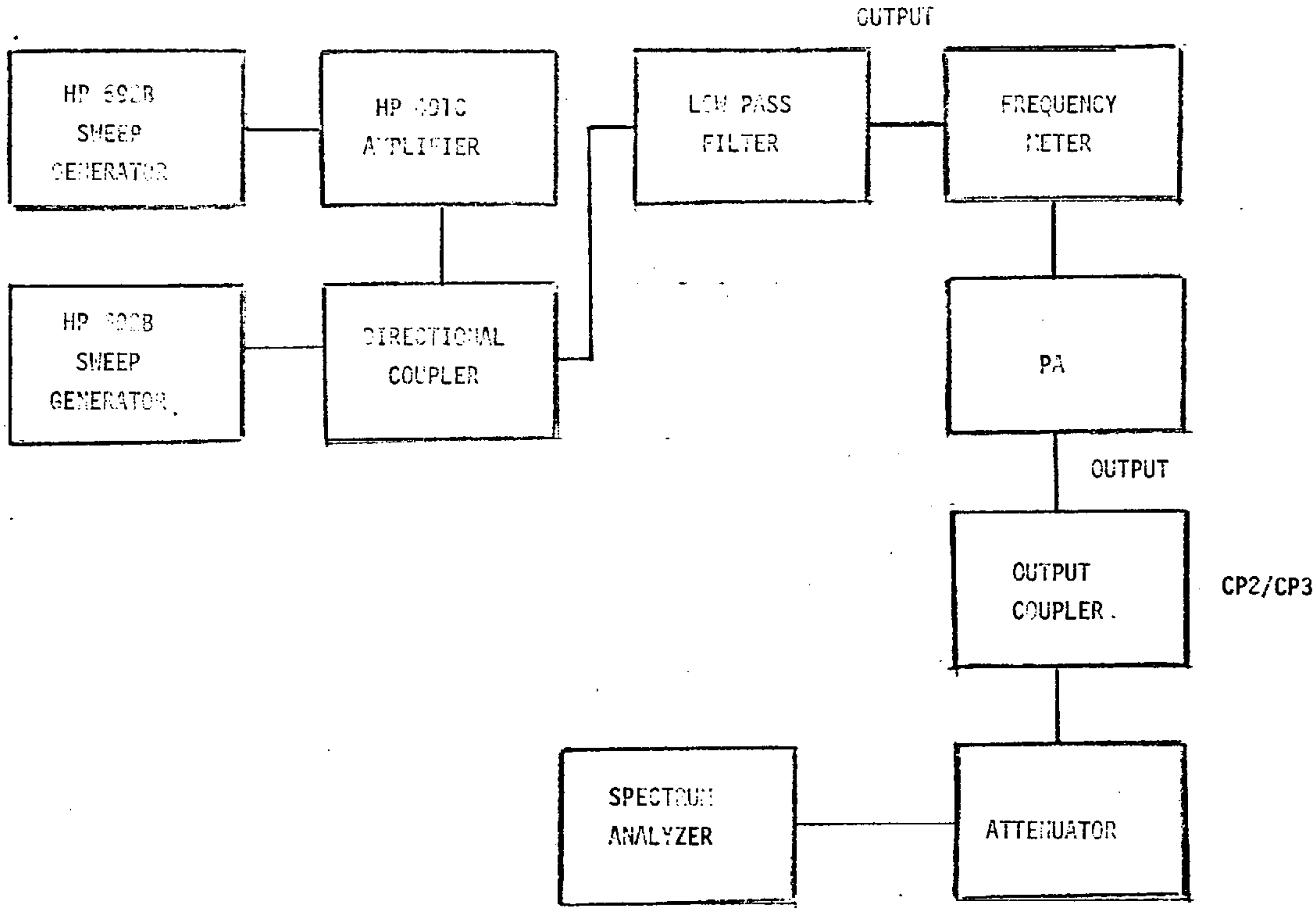

SWEEP
SWEEP
GENERATOR
AMPLIFIER
DIRECTIONAL
COUPLER
FILTER
OUTPUT
FREQUENCY
METER
PA
OUTPUT
OUTPUT
COUPLER
CP2/CP3
ANALYZER
ATTENUATOR

Figure 3.0

5.17 Spurious Outputs

Step 1.

Set up test equipment as shown in Figure 4.0.

Step 2.

With input to klystron amplifier terminated in a 50-ohm load, raise beam voltage to level which would produce maximum power output.

Step 3.

Using the spectrum analyzer, determine there are no discernible spurious signals. Record.

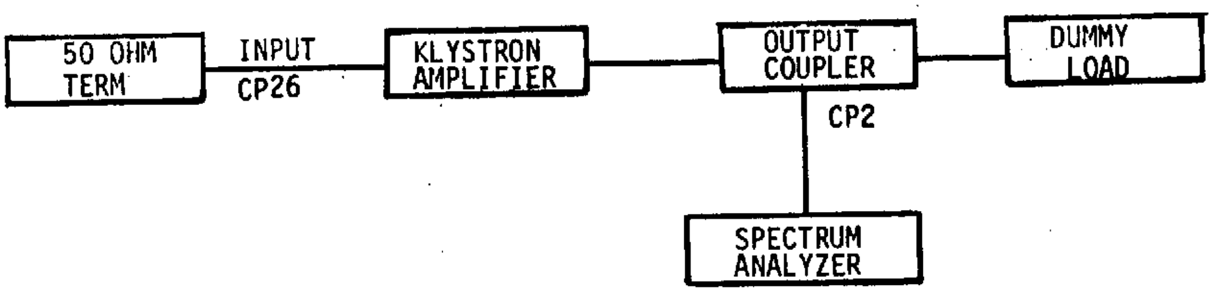


Figure 4.0

6.0 INSTALLATION OF 5K70SK-WBT KLYSTRON TUBE

6.1 Removal of 5K70SG Klystron Tube

Remove the 5K70SG tube in accordance with Paragraph 2.12.5, 2.12.6 and 2.12.7 of Technical Manual for the S-Band Klystron Power Amplifier Subsystem, Model 11-076.

6.2 Installation of 5K70SK-WBT

The 5K70SK-WBT klystron tube is installed identically to the 5K70SG tube and may be accomplished by following the procedure referenced in 6.1 above.

6.3 Installation of Remote Tuning Unit

See Addendum A

7.0 SYSTEM TESTS

The GFE provided equipment and the Collins-supplied heat exchanger was checked for correct operation in the preceeding paragraphs. Specification compliance of the 5K70SK-WBT klystron tube and remote tuning unit was identified at the supplier, Varian Associates. The Varian procedure, Publication No. 87-800-215, was used during this verification. The tests to be performed at Collins Radio will prove the interface of the new klystron tube with the GFE power amplifier equipment.

7.1 Preliminary Requirements

Step 1.

Ensure the klystron tube and tuner have been installed in accordance with Paragraph 6.2 and 6.3 above. ✓

Step 2.

Verify the following:

a. All equipment operational. ✓

b. Manual/auto switch 10-7/S1 in MANUAL ✓

c. Klystron filament and magnet supplies adjusted to tube manufacturers recommendations. ✓

d. RF driver off. ✓

7.2 Power Amplifier System Turn-on

Step 1.

Depress PA SYSTEM ON switch on control panel. System will turn on and KLY FIL TD and MAG U/C interlock lamps will turn on. Depress INTLK RESET to release MAG U/C interlock. ✓

Step 2.

Check out filament and magnet currents and voltages. They should be within the following ranges, depending upon the particular tube and magnet. (Check meter readings with tube data chart. There may be slight discrepancies between the meter readings since factory conditions are not identically repeatable.)

Klystron FIL AMPS:	11 to 13 A	11.3
FIL VOLTS:	7.0 to 8.0 V	7.5
Magnet DC AMPS:	16 to 22 A	17.5
DC VOLTS:	100 to 160 V	105

Step 3.

Check flow panel meters for following conditions:

COLL FLOW:	19 to 23 gal/min	22
BODY FLOW:	1 to 2 gal/min	1.55
RF DUMMY LOAD:	3.5 to 4.5 gal/min	3.7
INLET PRESSURE:	65 to 75 psi	80
OUTLET PRESSURE:	0 to 6 psi	0

Step 4.

Set meter relays to the following settings:

BODY CURRENT	75 mA	✓
BEAM CURRENT:	~~2.5~~ A 3.0 HRC	3.0
BEAM VOLTAGE:	22 kV	✓
OUTPUT REFL.	~~0.3~~ kW 0.5 HRC	✓
OUTPUT FWD:	22 kW	✓
MAGNET DC AMPS:	16 A	✓

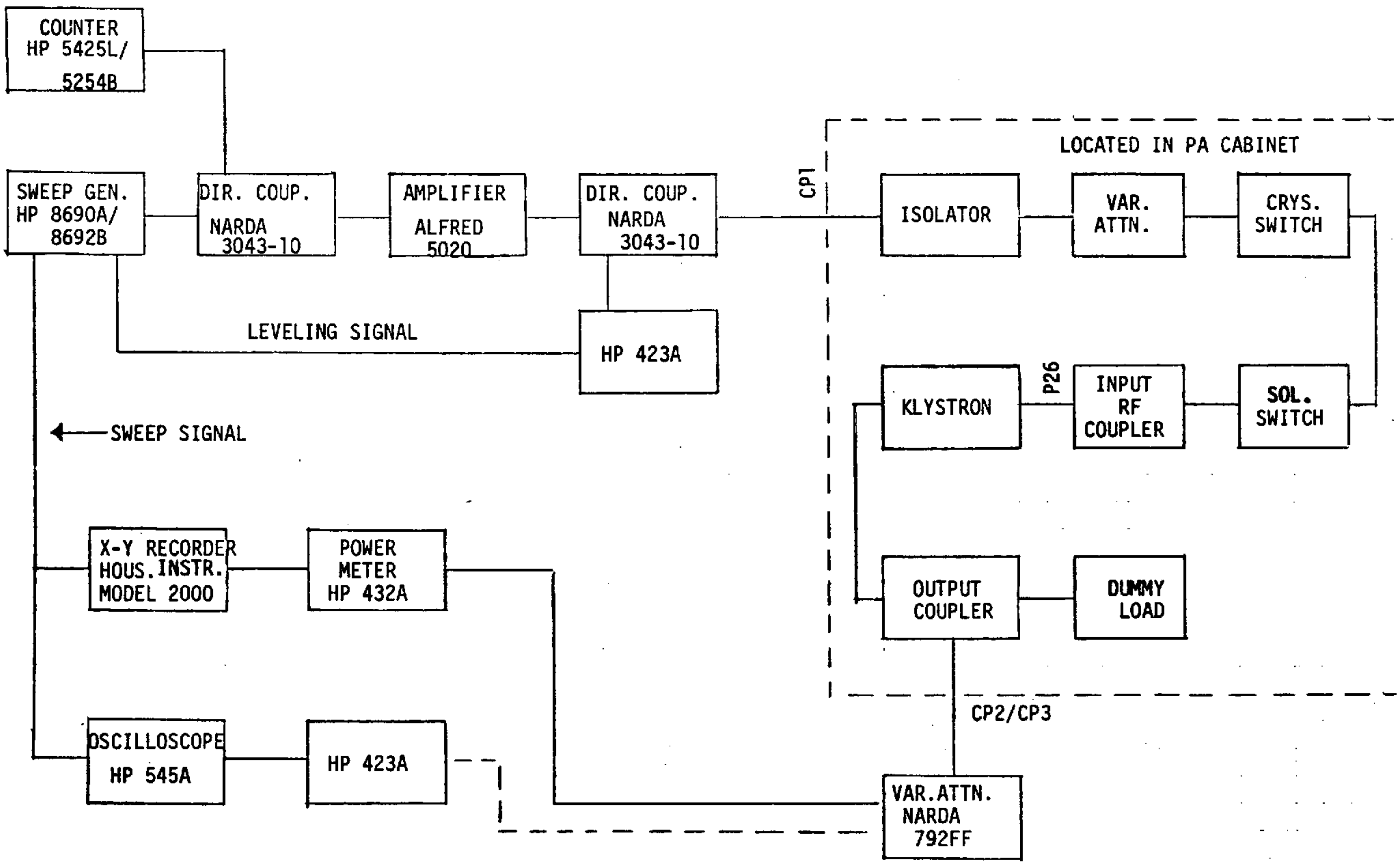

COUNTER
HP 5425L/
5254B
SWEEP GEN.
HP 8690A/
8692B
DIR. COUP.
NARDA
3043-10
AMPLIFIER
ALFRED
5020
DIR. COUP.
NARDA
3043-10
CP1
LOCATED IN PA CABINET
ISOLATOR
VAR.
ATTN.
CRYS.
SWITCH
LEVELING SIGNAL
HP 423A
KLYSTRON
P26
INPUT
RF
COUPLER
SOL.
SWITCH
SWEEP SIGNAL
X-Y RECORDER
HOUS. INSTR.
MODEL 2000
POWER
METER
HP 432A
OUTPUT
COUPLER
DUMMY
LOAD
CP2/CP3
OSCILLOSCOPE
HP 545A
HP 423A
VAR. ATTN.
NARDA
792FF

FIGURE 5.0

Step 5.

Set RF DRIVE ATTENUATION to maximum attenuation. ✓

Step 6.

Set RF LOAD switch to DUMMY position. ✓

Step 7.

After 5-minute time delay has elapsed allow another 5 minutes for further filament stabilization, then depress BEAM VOLTAGE ON switch to apply the high voltage. Verify that the meter readings are approximately as follows:

BODY CURRENT:	5 mA	3
BEAM CURRENT:	0.4 A	0.45
BEAM VOLTAGE:	7 kV	6.3

Step 8.

Raise beam voltage by means of the BEAM RAISE switch to the level shown on the tube data sheet as given below for 20 kW RF output operation. Body current may need to be minimized by adjusting the klystron electromagnetic current control. Meter readings should be within the following ranges:

BODY CURRENT:	20 to 40 mA HRC	9
BEAM CURRENT:	2.0 to ~~2.2~~ A 2.5 HRC	2.15
BEAM VOLTAGE:	18 to ~~20~~ kV 21 kV	20.5
MAGNET DC AMPS:	17 to 22 A	17.1

Step 9.

Remove beam voltage. ✓

7.3 Power output Measurement

Step 1.

Set up the test equipment as illustrated in Figure 5.0. Set rf drive to 2031 MHz CW at minimum power level. ✓

Step 2.

Apply beam voltage to klystron and select Channel 1 on remote tuner. ✓

Step 3.

Increase rf drive and beam voltage to obtain maximum power output. Observe water load temperature differential and calculate power output. Record.

POWER METER +8.8 dB	22.5 KW	#1
8.6	21.4	#2
9.0	21.0	#3
8.7	21.2	#4
8.65	20.5	#5
8.9	21.5	#6

Step 4.

Remove rf and select Channel 2. Repeat Step 3 for Channels 2 through 6. Record maximum power output with rf drive set at center frequency of each channel.

AT 20KW (WATER LOAD) SYSTEM POWER METER READS

8.15 dBm	#1
8.3	2
8.5	3
8.4	4
8.5	5
8.6	6

7.4 Bandwidth Measurement

Step 1.

With the test equipment set up as in Paragraph 7.3 and Channel 1 selected on the tuner, set the sweep generator to produce 20 kw output with a CW signal at 2031 MHz. Determine the 1 dB point on the recorder by inserting a 1 dB pad ahead of the detector. Mark the 1 dB point on the recorder for future reference and remove the pad. * DETERMINED FOR EACH BANDPASS USING HP432 POWER METER. ✓

Step 2.

Change the rf drive to sweep mode with a sweep time of ten seconds and with a deviation in excess of 22 MHz. ✓

Record the output trace of the passband. Switch the sweep generator to manual and calibrate the X-axis using the frequency meter and manual sweep. ✓

Determine the 1 dB bandwidth from the calibration determined in Steps 1 and 2. * SEE GRAPHS ✓

Step 3.

Remove the drive and switch tuner to Channel 2. Repeat Steps 1 and 2 for Channel 2. Record the bandwidth on the X-Y recorder and label recording. Repeat for Channels 3 through 6.

* SEE GRAPHS ✓

Step 4.

Repeat steps 1 thorugh 3 with beam voltage and drive adjusted to achieve 1 kw power output. Record the bandwidth on the X-Y recorder and label recording.

✓

7.5 Linearity

Repeat the tests as described in Paragraph 5.16, for each of the six channels. Space the two frequency generator outputs four MHz apart centered about the center frequency of the channel under test. Record.

	LOW SIDE	HIGH SIDE
Channel 1	-32dB	-32dB
Channel 2	-32	-33
Channel 3	-32	-33
Channel 4	-32	-36
Channel 5	-31	-33
Channel 6	-33	-36

7.6 Spurious Outputs

Repeat the tests as described in Paragraph 5.17 for each of the six channels. Be certain the input to the klystron is terminated and the beam voltage removed prior to switching channels. Record any signals noted.

* NO SIGNALS NOTED.

Channel 1	✓
Channel 2	✓
Channel 3	✓
Channel 4	✓
Channel 5	✓
Channel 6	✓

7.7 Remote Tuning Unit

Step 1.

With the test equipment connected as in Figure 2.0 and with the klystron set to operate at 1.0 kw, verify proper operation of tuning unit and remote panels by selecting channels 1 through six at each of the control locations. Determine that counters read correctly as each switch is activated and that control from all panels is identical. Verify achievement of correct operating bandpass at the completion of each tuning cycle. ✓

Step 2.

As each channel is selected from each control location, verify the "tuning" light comes on and that the drive interlock relay actuates. The output passband as displayed on the oscilloscope should disappear during the switching cycle. ✓

Step 3.

MAX. TIME 17 SEC.

Determine the time required to complete each switching cycle. Verify the time required does not exceed 30 seconds. ✓

Step 4.

Demonstrate retrievability of tuning. Selecting one of the channels, record a passband on the X-Y recorder. Switch the tuning unit to another channel and then reselect the original channel. Record the second passband over the first. Compare the two recordings to verify the tuner has returned the tube to the original setting within specification limits. SEE GRAPHS

Step 5.

Demonstrate interchangeability of channels by selecting one of the channels, record a passband on the X-Y recorder. Set up another channels digit switch settings to settings corresponding to the first channel selected. Select the other channel (which should not be in the same tuning position as the first channel selected) and record the passband again. Compare the two recordings to confirm both channels are identical within specification limits. SEE GRAPHS

ADDENDUM A

1.0 INSTALLATION PROCEDURE

This procedure should be followed for installing the Summit Model 8191 Step Tuner Unit on the H-193 magnetic circuit. Figure A.1 should be used as reference during the installation.

a. Loosen the 10-32 hex socket head screws on the split collar securing the shaft extensions to drive shaft.

b. Retract shaft extensions toward the step tuner assembly so that shaft assembly is as short as possible.

c. Set all turns counters (adjacent to tuner knobs) to "000". The proper procedure for setting "000" is as follows:

   Rotate tuner knobs in a clockwise direction until counters have passed through "000" to "995". Return to "000" in a counter-clockwise direction.

d. Remove four 10-24 x 3/4" socket head screws securing the top magnetic pole piece to the magnetic return cylinder.

e. Position the step tuner unit so that the four holes in the tuner top mounting flange are aligned with the four 10-24 tapped holes in the magnetic circuit and secure with four 10-24 x 1" socket head screws. Do not tighten screws.

f. The lower mounting flange of the step tuner is secured to the lower mounting flange of the magnetic circuit with two 3/8-18 x 1" long bolts using nuts and lock washers. After tightening the 3/8" bolts, tighten the 10-24 x 1" screws securing the top mounting flange of the step tuning unit.

g. Assuming the 5K70SK-WBT klystron has been "Zero" indexed, (reference paragraph 2.0 of this Addendum) engage the hexagonal shaft extensions with the hexagonal socket of the klystron tuner screw.

   When engaging the hexagonal shaft extensions, rotate the shaft in a counter-clockwise direction until the hexagonal sections mate. Care must be exercised during this process to insure that the "Zero" indexing of the klystron is not disturbed.

h. After engagement of the hexagonal shaft extension and the klystron tuning screw, re-check the "000" position of the turns counters. If they have been disturbed, return to "000" as in step c.

i. While maintaining a slight inward pressure on the shaft extension, tighten the 10-32 hex socket head screws on the split collar that locks the shaft extension to the drive shaft.

2.0 "ZERO" INDEXING OF KLYSTRON

The 5K70SK-WBT klystron will normally be shipped in a pre-tuned "Zero" indexed condition. The following paragraph describes the procedure followed in establishing the "Zero" index. Should the "zero" condition be lost on any tube, this procedure may be used to reset the tube.

During factory set-up, all cavity tuners are rotated clockwise to a positive stop which represents the end travel of the cavity tuner. At this point matching lines are scribed on the tuning screw and the housing of the tuner assembly. See Figure A.2. This setting should not be confused with the "Zero" index referred to in the preceding paragraphs. The "Zero" index is a factory determined number of turns, rotated counter-clockwise away from the positive clockwise stop.

For example, on 5K70SK-WBT Serial #1 all tuners were "Zero" indexed at 4 turns counter-clockwise from the fully clockwise positive stop. The number of turns required to establish the "Zero" index was recorded on the test data card accompanying 5K70SK-WBT Serial #1. A copy of this data card is shown as Figure A.3. Not all tubes will necessarily be "Zero" indexed at 4 turns counter-clockwise, but the required number of turns will be shown on the test data card for each tube.

In the event that the klystron tuning screws become mis-indexed with the step tuner unit, the following procedure should be followed to establish proper relationship between step tuner and klystron:

a. Loosen and retract all shaft extensions, disengaging shaft extensions from the klystron.

b. Remove step tuner unit from magnetic circuit.

c. Remove one shaft extension from a drive shaft to use as tuning tool.

d. Re-establish "Zero" indexing of klystron by returning klystron tuning screws to the clockwise positive stop and then rotating tuning screws counter-clockwise the number of turns recorded on the test data card until the scribe lines are precisely aligned. NOTE: Scribe lines must always be approached and aligned from the counter-clockwise direction. If correct alignment is "over-shot" rotate two full turns clockwise and reapproach alignment from the counter-clockwise direction.

e. Attach step tuner unit to magnetic circuit and engage hexagonal extension shafts as previously described.

3.0 PREPARING STEP TUNER FOR OPERATION

After installation of the step tuner unit and engagement with the klystron amplifier, the thumb-wheel counters on the front of the step tuner unit may be set to agree with the thumb-wheel counter settings given on the test data card (See Figure A.3).

The thumb-wheel counter settings represent the proper klystron cavity tuning to establish a 22 MHz Bandpass centered on the following frequencies:

Channel	1	2031 MHz
"	2	2048
"	3	2065
"	4	2082
"	5	2099
"	6	2116

After setting all thumb-wheel counters to agree with readings given on the test data card, engage the three interconnecting cables to the three input jacks found on the top surface of the step tuner unit.

Functions of the three jacks are:

J13	28 VDC power input
J14	Parallel connector for remote panel
J15	Relay closure for de-energizing RF drive during channel change

After connection is made to J13, the channel tuner is ready for operation. When energized with 28 VDC, the tuner unit may select an arbitrary channel or may remain stationary with a red light indicating tuning in process. In either case, merely depress the push button for the desired channel and it will be tuned automatically.

No damage will occur if push buttons are depressed during any part of the tuning cycle.

4.0 ESTABLISHMENT OF THUMB-WHEEL COUNTER SETTINGS

In the event that field re-tuning or "trimming" is required, it is necessary to understand how the thumb-wheel counter settings are originally established under factory tuned conditions. Individual channel band-pass characteristics are factory established using sweep frequency techniques.

Shown in Figure A.4 are typical klystron cavity positions for proper operation on Channel 1, (frequency centered on 2031 MHz). The band-pass shown in Figure A.4 is typical of the band-pass to be expected with small signal input of approximately 10 mw.

Cavities C & D on all channels form the upper and lower band edges and are placed at approximately + 11 MHz and - 11 MHz respectively. Cavities A & E are roughly centered on the channel center frequency. Cavity B is above band center and affects the band-pass only to a small degree, but has a strong effect on the overall gain of the klystron.

The band-pass is obtained by hand tuning the 5 knobs found on the front of the step tuner unit. When the hand tuning process is finished, the turns counters coupled to the stepping motor shafts will give a read out which is directly transferred to the thumb-wheel counters for Channel 1.

After transferring turns counter readings to thumb-wheels, automatic operation on Channel 1 is checked by depressing any other channel push button, then quickly re-depressing the Channel 1 push button. During this procedure, the step tuner will return to "000", reverse, and return to Channel 1. If band-pass characteristics are correct, nothing further need be done, and the process is repeated on Channel 2. If band-pass characteristics are not correct, re-trimming will be required, in which case slightly different turns counter readings will be obtained. These new readings are then transferred to thumb-wheel settings for Channel 1.

<u>Important Note</u>: In order to maintain repeatability, all final cavity tuning adjustments are made by turning the tuning knob in the counter-clockwise direction. If it is necessary to make a frequency adjustment requiring a clockwise rotation of the tuning knob, it is necessary to "over-shoot" in the clockwise direction and return to the proper position in a counter-clockwise direction.

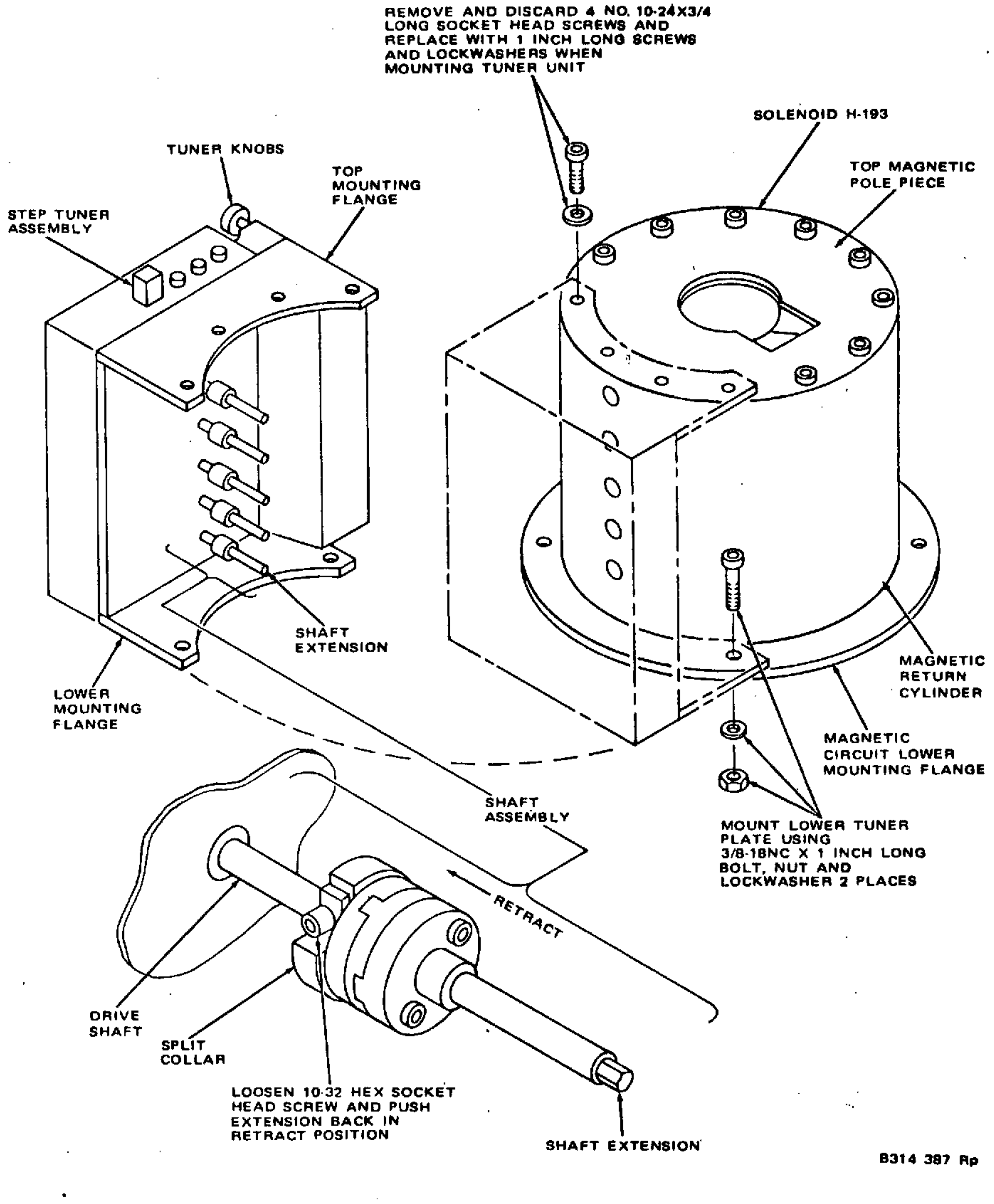

REMOVE AND DISCARD 4 NO. 10-24X3/4 LONG SOCKET HEAD SCREWS AND REPLACE WITH 1 INCH LONG SCREWS AND LOCKWASHERS WHEN MOUNTING TUNER UNIT
SOLENOID H-193
TUNER KNOBS
TOP MOUNTING FLANGE
TOP MAGNETIC POLE PIECE
STEP TUNER ASSEMBLY
SHAFT EXTENSION
LOWER MOUNTING FLANGE
MAGNETIC RETURN CYLINDER
MAGNETIC CIRCUIT LOWER MOUNTING FLANGE
SHAFT ASSEMBLY
MOUNT LOWER TUNER PLATE USING 3/8-16NC X 1 INCH LONG BOLT, NUT AND LOCKWASHER 2 PLACES
RETRACT
DRIVE SHAFT
SPLIT COLLAR
LOOSEN 10-32 HEX SOCKET HEAD SCREW AND PUSH EXTENSION BACK IN RETRACT POSITION
SHAFT EXTENSION
B314 387 Rp

FIGURE A.1

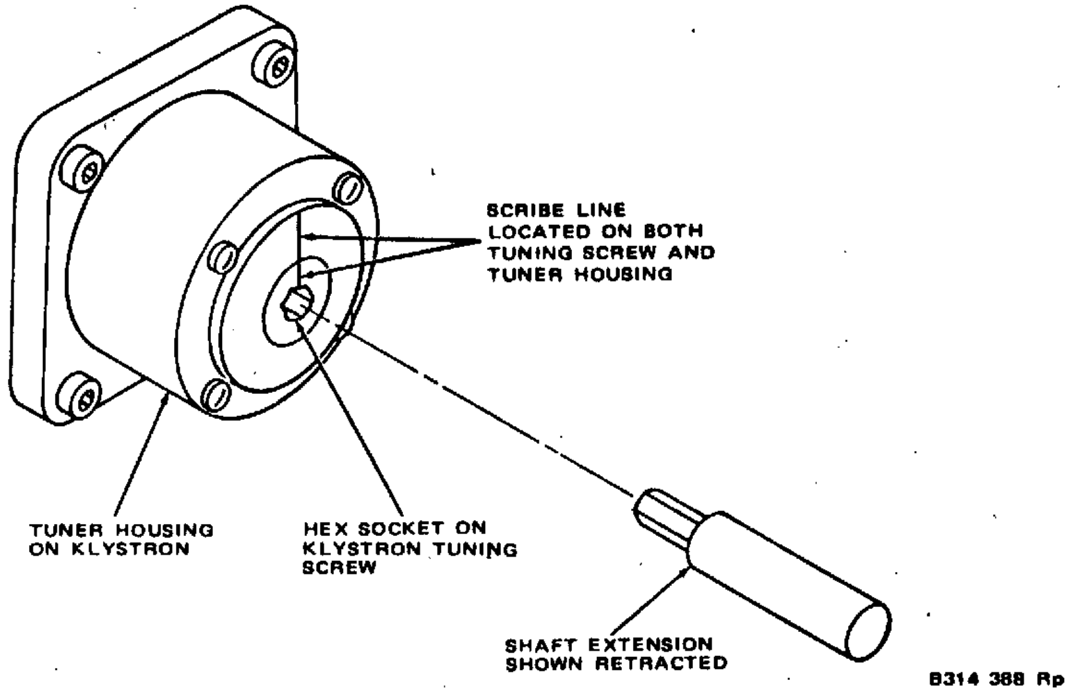


FIGURE A.2

TUBE TYPE 5K70SK-WBT

TUBE SERIAL NO. 1

ZERO INDEX 4 TURNS FROM CW STOP

STEP TUNER THUMBWHEEL SETTING					
CHANNEL	A	B	C	D	E
1	370	234	128	098	163
2	447	368	265	235	310
3	544	494	387	371	430
4	621	591	502	483	543
5	693	638	608	585	648
6	754	709	694	679	734

B314 390 RP

FIGURE A.3

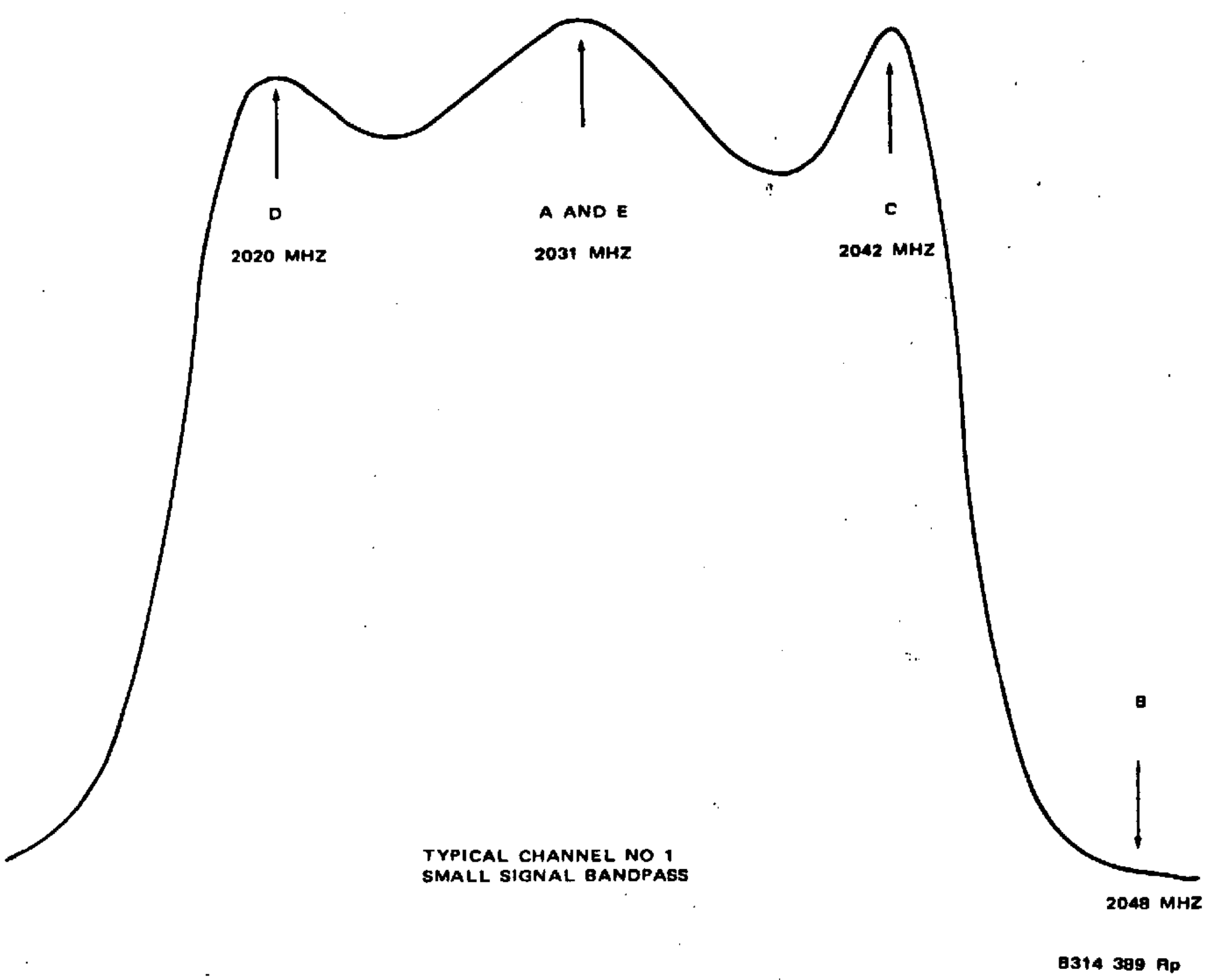

D
2020 MHZ
A AND E
2031 MHZ
C
2042 MHZ
B
2048 MHZ
TYPICAL CHANNEL NO 1
SMALL SIGNAL BANDPASS
B314 389 Rp

FIGURE A.4

1.0 SCOPE

THIS SPECIFICATION DETAILS THE REQUIREMENTS FOR A CW KLYSTRON AMPLIFIER 24 KW, TUNABLE OVER THE 2025 TO 2120 MHZ BAND, FIVE INTEGRAL CAVITIES, COAXIAL INPUT WAVEGUIDE OUTPUT, ELECTROMAGNETICALLY FOCUSED, LIQUID AND FORCED-AIR COOLED. THE UNIT SHALL BE DESIGNED TO INTERFACE WITH A REMOTE CONTROLLED SIX POSITION CHANNEL TUNER INSTALLED ON THE ELECTROMAGNET.

COLLINS RADIO COMPANY

DALLAS, TEX NEWPORT BEACH, CALIF CEDAR RAPIDS, IA

PREP R.S. Kellow

CHK

APVD R.S. Kellow 10-9-72

ELECTRON TUBE, KLYSTRON

A

090-0046-257

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-E-1 GENERAL SPECIFICATIONS FOR ELECTRON TUBES

2.2 COLLINS SPECIFICATIONS

090-0047-257 REMOTE CONTROLLED SIX POSITION CHANNEL TUNER

3.0 REQUIREMENTS

3.1 ELECTRICAL REQUIREMENTS

3.1.1 ABSOLUTE RATINGS, NOTE 6.1.

PARAMETER:	EF	IF(SURGE)	EB	IB	PCOL	IBY	LOAD VSWR
UNIT:	V	A	KVDC	ADVC	KW	MADC	
MAXIMUM:	7.88	24	22	3.2	70	75	1.5
MINIMUM:	7.12	---	---	---	---	---	---

PARAMETER:	IGET	TK	COOLANT OUTLET TEMP	E/G WATER COOLANT FLOW COLLECTOR	E/G WATER COOLANT FLOW BODY	HYDROSTATIC PRESSURE
UNIT:	AAC	MIN	°C	GPM	GPM	PSIG
MAXIMUM:	34	---	80	---	---	125
MINIMUM:	---	5	---	18.5	1.2	---
	NOTE 5					

3.1.2 DETAIL PERFORMANCE REQUIREMENTS

3.1.2.1 BANDWIDTH (1 DB) (SEE NOTE 6.7):

22 MHZ MINIMUM (30 MHZ DESIGN GOAL) UNDER CONDITIONS OF PARAGRAPH 3.1.2.2, AND OVER A RANGE OF OUTPUT POWER FROM 1 KW TO 24 KW.

3.1.2.2 POWER OUTPUT

24.0 KW CW MINIMUM, UNDER CONDITIONS SPECIFIED IN NOTE 6.9.

3.1.2.3 GAIN

(P OUT/P DRIVE): 45 DB MINIMUM, UNDER CONDITIONS OF PARAGRAPH 3.1.2.2.

3.1.2.4 EFFICIENCY

(P OUT/P IN DC): 39% MINIMUM, UNDER CONDITIONS OF PARAGRAPH 2.1.2.2.

3.1.2.5 HARMONIC OUTPUT: (CONDITIONS OF 3.1.2.2) (SEE NOTE 6.8)

2ND AND 3RD: 30 DB BELOW FUNDAMENTAL

ALL OTHERS: 50 DB BELOW FUNDAMENTAL

3.1.2.6 SPURIOUS OUTPUTS

AT FREQUENCIES WITHIN ±50 MHZ OF THE TUNED CENTER FREQUENCY, THE NOISE AND SPURIOUS OUTPUTS SHALL NOT EXCEED, IN ANY ARBITRARY BANDWIDTH, THAT LEVEL CORRESPONDING TO THE AMPLIFIED EXCESS NOISE OF A DEVICE HAVING A NOMINAL NOISE FIGURE OF 35 DB. AT FREQUENCIES REMOVED BY MORE THAN 500 MHZ, THE OUTPUT NOISE LEVEL SHALL NOT BE GREATER THAN 30 DB ABOVE THERMAL (-114 DBM/MHZ). THERE SHALL BE NO EVIDENCE OF DISCRETE OSCILLATIONS OR UNDESIRED OUTPUTS AT ANY FREQUENCY. SEE NOTE 6.8 REGARDING TUBE RADIATION LEVELS.

3.1.2.7 AMPLITUDE RESPONSE

WITH A CONSTANT DRIVE LEVEL, THE TUBE AMPLITUDE RESPONSE SHALL NOT VARY MORE THAN ±0.5 DB (1.0DB PEAK-TO-PEAK) OVER THE CENTER 22 MHZ OF THE PASSBAND. THIS REQUIREMENT SHALL BE MET OVER A RANGE OF OUTPUT FROM 24.0 KW TO 1 KW.

3.1.2.8 TUNING

THE KLYSTRON SHALL BE DESIGNED TO INTERFACE WITH THE STEP TUNER (CPN 090-0047-257). THE KLYSTRON DESIGN AND FACTORY TUNING PROCEDURE SHALL BE SUCH AS TO INSURE THAT THE SPECIFIED RF PERFORMANCE AT EACH FREQUENCY CHANNEL SPECIFIED IN TABLE I IS RETRIEVEABLE IN THE FIELD WITHOUT SWEPT FREQUENCY ALIGNMENT. THIS REQUIREMENT SHALL BE ADDRESSED IN THE FIRST DESIGN REVIEW, AND SHALL BE DEMONSTRATED PRIOR TO FINAL ACCEPTANCE.

THE KLYSTRON SHALL BE GUARANTEED TO MEET THE SPECIFICATIONS HEREIN THROUGH A MINIMUM OF 1000 TUNING CYCLES.

3.1.2.9 HEATER CURRENT

THE HEATER CURRENT SHALL BE BETWEEN 9.5 AND 13.0 AMPS, AC OR DC, WITH AN APPLIED VOLTAGE OF 7.5 VOLTS AT THE TUBE LEADS.

3.1.2.10 WARM-UP TIME

THE TUBE SHALL BE CAPABLE OF PRODUCING RATED OUTPUT WITH A HEATER PRE-HEAT TIME OF 5 MINUTES MAXIMUM.

3.1.2.11 CATHODE CURRENT

THE BEAM CURRENT SHALL NOT EXCEED 2.78 ADC WITH RATED BEAM VOLTAGE, AND 7.5 V HEATER VOLTAGE APPLIED.

3.1.2.12 BODY CURRENT

THE BODY CURRENT SHALL NOT EXCEED 75 MA DC UNDER NORMAL OPERATING CONDITIONS, WITH OR WITHOUT RF DRIVE.

3.1.2.13 BEAM VOLTAGE

THE BEAM VOLTAGE REQUIRED SHALL BE BETWEEN 7 AND 22 KV.

3.1.2.14 LINEARITY

THE THIRD ORDER INTERMODULATION PRODUCTS FOR A TWO TONE INPUT PRODUCING 2.380 KW OUTPUT FOR EACH FREQUENCY SHALL BE 30 DB BELOW THE 2.38 KW LEVEL. THE TWO TONES MAY HAVE ANY ARBITRARY FREQUENCY SEPARATION BETWEEN 1.5 AND 20 MHZ.

3.1.2.15 EMISSION

THE TUBE SHALL BE ALLOWED TO STABILIZE UNDER STANDARD DC CONDITIONS FOR 15 MINUTES, AFTER WHICH THE HEATER VOLTAGE SHALL BE REDUCED TO 6.75 VOLTS. AFTER 15 MINUTES OF STABILIZATION AT THE REDUCED HEATER VOLTAGE, THE BEAM CURRENT SHALL BE MEASURED AND THE CHANGE IN BEAM CURRENT SHALL NOT EXCEED 200 MA DC.

3.1.2.16 FOCUSING

THE KLYSTRON SHALL BE ELECTROMAGNETICALLY FOCUSED BY THE H-193 ELECTROMAGNET ASSEMBLY. THE FOCUS CURRENT REQUIRED SHALL NOT EXCEED 25 AMPERES FROM A VOLTAGE SOURCE BETWEEN 0 AND 200 VDC. THE OPTIMUM VALUE SHALL BE DETERMINED IN FINAL TEST AND SHALL BE SPECIFIED ON THE FINAL TUBE DATA SHEET. THIS SINGLE OPTIMUM VALUE SHALL BE USED THROUGHOUT THE ACCEPTANCE TEST SERIES, FOR ALL FREQUENCIES AND POWER LEVELS.

3.2 MECHANICAL REQUIREMENTS

3.2.1 INTERFACE

THE KLYSTRON SHALL BE MECHANICALLY INTERCHANGEABLE WITH THE 5K70SG, AND SHALL MOUNT IN THE H-193 CIRCUIT ASSEMBLY. THE H-193 MAY BE MODIFIED, IF NECESSARY, TO ACCEPT THE STEP TUNER ASSEMBLY AS REQUIRED. ALL ELECTRICAL CONNECTIONS, WAVEGUIDES, COAXIAL JACKS, COOLANT FITTINGS, ETC. SHALL INTERFACE IDENTICALLY WITH THE 5K70SG.

3.2.2 MOUNTING POSITION:

ANY

3.2.3 HYDROSTATIC PRESSURE

WITH ALL TUBE OUTLETS CLOSED, INLET PRESSURE SHALL BE RAISED TO 125 PSIG. NO LEAKAGE SHALL OCCUR.

3.2.4 PRESSURE DROPS

3.2.4.1 BODY SECTION

65 PSI AT 1.2 GPM

3.2.4.2 COLLECTOR

40 PSI AT 18.5 GPM

3.2.5 TUNER TORQUE

THE TORQUE REQUIRED TO TUNE THE TUBE OVER THE REQUIRED RANGE SHALL NOT EXCEED 80 IN-ON.

3.2.6 COLLECTOR DISSIPATION

THE KLYSTRON SHALL BE OPERATED AT 22 KV DC WITHOUT RF DRIVE, AND WITH THE COLLECTOR FLOW REDUCED TO 13 GPM OR LESS. THE TUBE SHALL OPERATE WITHOUT ARCS WITHIN THE TUBE FOR AT LEAST 15 MINUTES. THE COLLECTOR COOLANT SHALL NOT BOIL DURING THIS PERIOD.

3.2.7 WEIGHT

100 LBS. NOMINAL

3.3 ENVIRONMENTAL REQUIREMENTS

3.3.1 TEMPERATURE

STORAGE: -65°F TO +160°F

OPERATING: -25°F TO +130°F

3.3.2 RELATIVE HUMIDITY

0 TO 100%

3.3.3 ALTITUDE

0 TO 15,000 FT., OPERATING

0 TO 35,000 FT., STORAGE

3.3.4 SHOCK AND VIBRATION

AS REQUIRED FOR TRANSPORT BY COMMON CARRIERS OVER UNUSUALLY ROUGH TERRAIN.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 TESTING

AS A MINIMUM REQUIREMENT, THE VENDOR SHALL CONDUCT ACCEPTANCE TESTS IN ACCORDANCE WITH THE APPROVED TEST PROCEDURE WHICH WILL DEMONSTRATE THE FOLLOWING REQUIREMENTS:

3.1.2 (ALL SUB PARAGRAPHS EXCEPT 3.1.2.5, SEE NOTE 6.8).

3.2.1

3.2.3

3.2.4

3.2.5

3.2.6

5.0 PREPARATION FOR DELIVERY

THE UNITS SHALL BE PACKAGED IN A MANNER TO PREVENT DAMAGE DURING NORMAL SHIPPING AND HANDLING.

6.0 NOTES

6.1 REFERRING TO PARAGRAPH 6.5 OF MIL-E-1G, THESE VALUES ARE BASED ON THE "ABSOLUTE SYSTEM" AND SHOULD NOT BE EXCEEDED UNDER CONTINUOUS OR TRANSIENT CONDITIONS. A SINGLE RATING MAY BE THE LIMITATION AND SIMULTANEOUS OPERATION AT ANOTHER RATING MAY NOT BE POSSIBLE. DESIGN VALUES FOR SYSTEMS SHOULD INCLUDE A SAFETY FACTOR TO MAINTAIN OPERATION WITHIN RATINGS UNDER VOLTAGE AND ENVIRONMENTAL VARIATIONS.

6.2 ALL VOLTAGES EXCEPT THE HEATER VOLTAGES ARE REFERENCED TO THE CATHODE.

6.3 FOR OPTIMUM TUBE PERFORMANCE THE HEATER VOLTAGE MUST NOT BE PERMITTED TO DROP BELOW 7.13 VOLTS.

6.4 ELECTROMAGNET CURRENT MUST BE APPLIED, AT THE VALUE INDICATED ON THE TEST PERFORMANCE SHEET, BEFORE APPLICATION OF BEAM VOLTAGE.

6.5 THIS RATING REPRESENTS THE MAXIMUM VALUE WHICH MAY BE USED FOR GETTER FLASHING. DURING NORMAL OPERATION, THE GETTER SHALL BE OPERATED AT 24 AAC AND APPROXIMATELY 4.0 VAC.

6.6 CERAMIC-TO-METAL SEALS TO THE CATHODE END OF THE TUBE SHALL BE COOLED BY A FORCED AIR FLOW OF AT LEAST 20 CFM.

6.7 BANDWIDTH IS DEFINED AS THE DIFFERENCE IN FREQUENCY (ΔF) BETWEEN THE 1 DB POINTS. WITH THE TUBE OPERATING AT SPECIFIED OUTPUT POWER AND THE DRIVE POWER HELD CONSTANT THE DRIVE FREQUENCY SHALL BE VARIED BOTH UPWARD AND DOWNWARD TO REDUCE OUTPUT POWER BY 1 DB OF ITS ORIGINAL VALUE. THE SPECIFIED BANDWIDTH AND AMPLITUDE RESPONSE SHALL BE MAINTAINED OVER A RANGE OF OUTPUT LEVEL FROM 24 KW DOWN TO 1.0 KW BY ADJUSTMENT OF DRIVE LEVEL ONLY.

6.8 THE KLYSTRON SHALL BE CERTIFIED BY THE VENDOR TO HAVE EQUAL OR LOWER HARMONIC OUTPUT AND ELECTROMAGNETIC RADIATION LEVELS THAN THE 5K70SG.

6.9 THE TUBE SHALL BE TESTED FOR PERFORMANCE UNDER THE FOLLOWING CONDITIONS:

BEAM VOLTAGE:	22 KVDC, MAX.
HEATER VOLTAGE:	7.5 V
FO:	EACH OF SIX CHANNEL FREQ.
I MAGNET:	SEE PARAGRAPH 3.1.2.16
P DRIVE = SATURATION	0.750 WATTS MAXIMUM
LOAD VSWR $\leq$1.1	

THE FINAL TEST DATA SHALL BE RECORDED ON DATA SHEETS FURNISHED WITH EACH TUBE (3 COPIES). A PERMANENT LABEL, VISIBLE WITH THE TUBE INSTALLED, SHALL BE ATTACHED TO THE TUBE AND SHALL STATE THE OPERATING VOLTAGES AND CURRENTS OF THAT SPECIFIC TUBE.

TABLE I

SIX POSITION CHANNEL TUNER FREQUENCIES

CHANNEL NO.	CENTER FREQUENCY (MHZ)	1 DB MINIMUM BANDWIDTH, MHZ
1	2031	22
2	2048	22
3	2065	22
4	2082	22
5	2099	22
6	2116	22 (30 MHZ, DESIGN GOAL)

D

C

1.0 SCOPE

THIS SPECIFICATION DETAILS THE DESIGN REQUIREMENTS FOR A REMOTELY CONTROLLED KLYSTRON STEP TUNER, TO BE USED TO MODIFY THE UNIFIED S-BAND KLYSTRON POWER AMPLIFIER SUBSYSTEM MODEL 11-076. WHEN MODIFIED, THE TRANSMITTER WILL PROVIDE SIX (6) REMOTELY SELECTABLE 22 MHZ (MIN) BANDWIDTHS OVER THE 2025 TO 2120 MHZ BAND.

B

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COLLINS RADIO COMPANY
DALLAS, TEX NEWPORT BEACH, CALIF CEDAR RAPIDS, IA

PREP R.S. Kellow

CHK

APVD R.S. Kellow 10-2-72

REMOTELY CONTROLLED KLYSTRON STEP TUNER

A

090-0047-257

4 3 2 1

2.0 APPLICABLE DOCUMENTS

THE FOLLOWING DOCUMENTS ARE APPLICABLE TO THE EQUIPMENT PROVIDED IN ACCORDANCE WITH THIS DOCUMENT.

2.1 COLLINS SPECIFICATIONS

090-0046-257	ELECTRON TUBE, KLYSTRON
597-0601-002	QUALITY ASSURANCE REQUIREMENTS FOR VENDORS

2.2 GOVERNMENT SPECIFICATIONS

2.2.1 RELIABILITY AND QUALITY ASSURANCE PUBLICATION NHB 5300.4 (3A) "REQUIREMENTS FOR SOLDERED ELECTRICAL CONNECTIONS".

2.2.2 GSFC SPECIFICATION S-250-P-1B, "CONTRACTOR PREPARED MONTHLY, PERIODIC, AND FINAL REPORTS". (TYPE 1 MONTHLY REPORTS AND TYPE III FINAL REPORTS).

2.2.3 MIL-STD-461, "ELECTROMAGNETIC INTERFERENCE CHARACTERISTICS REQUIREMENTS FOR EQUIPMENT".

2.2.4 RELIABILITY AND QUALITY ASSURANCE PUBLICATION NHB 5300.4 (1C), JULY 1971, "INSPECTION SYSTEM PROVISIONS FOR AERONAUTICAL AND SPACE SYSTEM MATERIAL, PARTS, COMPONENTS, AND SERVICES", SECTIONS 1C102, 1C201, 1C202, 1C204, 1C304, 1C305, AND 1C310 ONLY ARE APPLICABLE.

2.2.5 GSFC SPECIFICATION S-572-P-3B; "ENGINEERING DRAWING STANDARDS AND SPECIFICATIONS."

2.2.6 MIL-H-46855 - HUMAN ENGINEERING REQUIREMENTS FOR MILITARY SYSTEMS, EQUIPMENT AND FACILITIES, DATED FEBRUARY 1968.

2.2.7 GSFC SPECIFICATION S-571-P-37A, "ENVIRONMENTAL REQUIREMENTS FOR STADAN EQUIPMENT", DATED JUNE 1970.

3.0 REQUIREMENTS

3.1 STEP TUNER ASSEMBLY

THE STEP TUNER ASSEMBLY SHALL CONSIST OF SERVO MOTORS, AMPLIFIERS, CALIBRATION POTENTIOMETERS, POWER SUPPLIES, GEARS, CLUTCHES, COUNTER READ-OUTS, ETC. AS REQUIRED TO PROVIDE A SIX POSITION AUTOMATIC CHANNEL SELECTOR FUNCTION FOR A BROADBAND KLYSTRON. THIS ASSEMBLY SHALL BE MOUNTED ON THE EXISTING H-193 MAGNET ASSEMBLY IN PLACE OF THE PRESENT MANUAL TUNER ASSEMBLY. THE H-193 MAGNET MAY BE FIELD MODIFIED IF NECESSARY TO ACCEPT THE STEP TUNER. SEE FIGURE 1 FOR CONCEPTUAL BLOCK DIAGRAM.

THE ASSEMBLY WILL INTERFACE WITH ANY NUMBER OF REMOTE CONTROL PANELS (NOT PART OF THIS SPECIFICATION) TO PROVIDE REMOTE CHANNEL SELECTION THROUGH APPROPRIATE MOMENTARY CONTACT CLOSURES.

3.2 ELECTRICAL REQUIREMENTS

3.2.1 REMOTE CHANNEL SELECTOR INTERFACE

THE STEP TUNER ASSEMBLY SHALL PROVIDE, ON A SEPARATE CONNECTOR, THOSE CONTROL LEADS NECESSARY TO REMOTELY SELECT ANY ONE OF THE SIX CHANNELS. NO MORE THAN 10 WIRES SHALL BE REQUIRED TO ACCOMPLISH CHANNEL SELECTION, READ-BACK OF CHANNEL SELECTED, AND THE TUNE CYCLE ALARM LAMP. IT SHALL BE POSSIBLE TO EXPAND CHANNEL SELECTOR LOCATIONS TO ANY NUMBER (UP TO 5 MAXIMUM) BY PARALLELING CONTROL WIRES. SEE FIGURE 2 FOR RECOMMENDED CIRCUITRY. SELECTOR LEADS SHALL NOT UTILIZE VOLTAGES IN EXCESS OF 30 V AC OR DC. THE INTERFACE VOLTAGES AND CURRENTS SHALL BE DEFINED AT THE FIRST DESIGN REVIEW. THE SELECTED CHANNEL INDICATOR LAMP SHALL REMAIN ILLUMINATED UNTIL ANOTHER CHANNEL IS SELECTED.

IN ADDITION TO SUCH INTERNAL POWER AS MAY BE REQUIRED, THE DESIGN SHALL PROVIDE FOR PARALLELING UP TO 5 REMOTE STATIONS. MAXIMUM LAMP LOADS WILL BE 0.5 AMPERE FOR CHANNEL INDICATOR LAMPS PLUS AN ADDITIONAL 0.5 AMPERE FOR "TUNE CYCLE" LAMPS, AT 28 VOLTS.

3.2.2 DRIVE INTERLOCK

TWO (2) FORM C RELAY CONTACTS SHALL BE PROVIDED ON A SEPARATE CONNECTOR ON THE STEP TUNER ASSEMBLY. THESE CONTACTS SHALL TRANSFER UPON CHANNEL CHANGE COMMAND AND SHALL TRANSFER BACK TO THE ORIGINAL POSITION AT THE END OF THE (MAXIMUM 30 SECONDS) TUNING CYCLE. THESE CONTACTS WILL BE USED IN THE SYSTEM TO INHIBIT DRIVE POWER DURING THE TUNING INTERVAL. CONTACT RATING SHALL BE 2 AMPERES, 28 VDC OR 115 VAC.

3.2.3 PRIMARY POWER

THE STEP TUNER ASSEMBLY SHALL OPERATE FROM 120 VAC ±10%, 60 HZ. THE PRIMARY POWER SHALL INTERFACE THROUGH A SEPARATE CONNECTOR. PRIMARY POWER PROTECTION FROM SHORTS, COMPONENT FAILURES, ETC. SHALL BE PROVIDED AS PART OF THE STEP-TUNER ASSEMBLY.

3.3.4 TUNING TIME

THE ELAPSED TIME BETWEEN SELECTION OF A NEW CHANNEL AND THE COMPLETION OF TUNING SHALL NOT EXCEED 30 SECONDS. A CONTROL LEAD SHALL BE ENERGIZED WITH NOMINAL 28 VOLTS DURING THE TUNING INTERVAL. THIS LEAD WILL BE USED TO ILLUMINATE "TUNE CYCLE" ALARM LAMPS AT REMOTE PANELS.

3.2.5 TUNING ACCURACY

THE ACCURACY OF THE STEP TUNER, INCLUDING ALL EFFECTS FROM ELECTRICAL AND MECHANICAL TOLERANCES, BACKLASH, TEMPERATURE, DRIFT, RESOLUTION, ETC., SHALL BE SUCH THAT THE KLYSTRON BANDWIDTH AND AMPLITUDE RESPONSE REQUIREMENTS ARE MET AT EACH CHANNEL FREQUENCY SPECIFIED.

3.3 MECHANICAL REQUIREMENTS

3.3.1 LOCATION

THE STEP TUNER ASSEMBLY SIZE SHALL NOT EXCEED 14 INCHES HIGH AND 14 INCHES WIDE. THE DEPTH OF THE ASSEMBLY SHALL BE SUCH THAT WHEN MOUNTED ON THE ELECTROMAGNET H-193, THE DISTANCE FROM THE TUBE AXIS TO MAXIMUM PROTECTION OF THE TUNER KNOB DOES NOT EXCEED 14 INCHES.

IF THE REQUIRED CIRCUITRY CANNOT BE LOCATED WITHIN THE BOUNDS SPECIFIED ABOVE, A SEPARATE PACKAGE MAY BE USED TO LOCATE CERTAIN PORTIONS OF THE CIRCUITRY. THIS SEPARATE PACKAGE FORM FACTOR MUST BE SUBJECT TO APPROVAL BY COLLINS RADIO COMPANY. IF A SEPARATE PACKAGE IS USED, IT SHALL NOT CONTAIN ANY ADJUSTMENTS WHICH ARE NEEDED TO CALIBRATE OR ADJUST THE STEP TUNER. ANY CABLES REQUIRED SHALL BE FURNISHED WITH THE UNITS (LENGTH TO BE SPECIFIED LATER). REFERENCE CALIBRATION ADJUSTMENTS FOR EACH CAVITY AND FREQUENCY CHANNEL SHALL BE LOCATED ON THE TUBE MOUNTED PORTION OF THE STEP TUNER, SUCH THAT THEY MAY BE ADJUSTED THROUGH A SMALL ACCESS DOOR IN FRONT OF THE TUBE.

3.3.3 MANUAL OPERATION

IT SHALL BE POSSIBLE TO TUNE THE KLYSTRON MANUALLY TO ANY FREQUENCY WITHIN THE 2025 TO 2120 MHZ RANGE BY USE OF KNOBS AND COUNTERS ON THE STEP TUNER ASSEMBLY SIMILAR TO THE PRESENT 5K70SG, IN THE EVENT OF ELECTRICAL FAILURE OF THE STEP TUNER ASSEMBLY.

3.4 DESIGN CONSTRAINTS

3.4.1 PARTS SELECTION

PARTS USED IN THE DESIGN OF THE STEP TUNER ASSEMBLY SHALL BE OF GOOD QUALITY, AND SHALL BE SELECTED FROM ONLY SOURCES HAVING ESTABLISHED HIGH RELIABILITY. SELECTION OF "QPL" ITEMS IS RECOMMENDED AS MEETING THESE REQUIREMENTS. USE OF NON-STANDARD AND SPECIAL PARTS SHALL BE HELD TO A MINIMUM.

3.4.2 RELAYS

RELAYS USED IN THE DESIGN OF THE STEP-TUNER SHALL BE OF A "PLUG-IN" DESIGN TO FACILITATE REPLACEMENT. USE OF SEALED RELAYS IS RECOMMENDED.

3.4.3 CONNECTORS

CONNECTORS SHALL BE IN ACCORDANCE WITH MIL-C-26482 FOR MINIATURE, QUICK-DISCONNECT, ENVIRONMENTALLY PROTECTED STYLES.

3.4.4 SOLDERING

ALL SOLDERING OF ELECTRICAL CONNECTIONS SHALL BE IN ACCORDANCE WITH NHB 5300.4(3A).

3.5 ENVIRONMENTAL REQUIREMENTS

3.5.1 TEMPERATURE:

STORAGE: -65°F TO +160°F

OPERATING: -25°F TO +130°F

3.5.2 RELATIVE HUMIDITY

0 TO 100%

3.5.3 ALTITUDE

0 TO 15,000 FT., OPERATING

0 TO 35,000 FT., STORAGE

3.5.4 SHOCK AND VIBRATION

AS REQUIRED FOR TRANSPORT BY COMMON CARRIERS OVER UNUSUALLY ROUGH TERRAIN.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 TESTING

AS A MINIMUM REQUIREMENT, THE VENDOR SHALL CONDUCT ACCEPTANCE TESTS AND INSPECTIONS IN ACCORDANCE WITH THE APPROVED TEST PROCEDURE WHICH WILL DEMONSTRATE THE FOLLOWING REQUIREMENTS:

3.1

3.2 (ALL SUB-PARAGRAPHS)

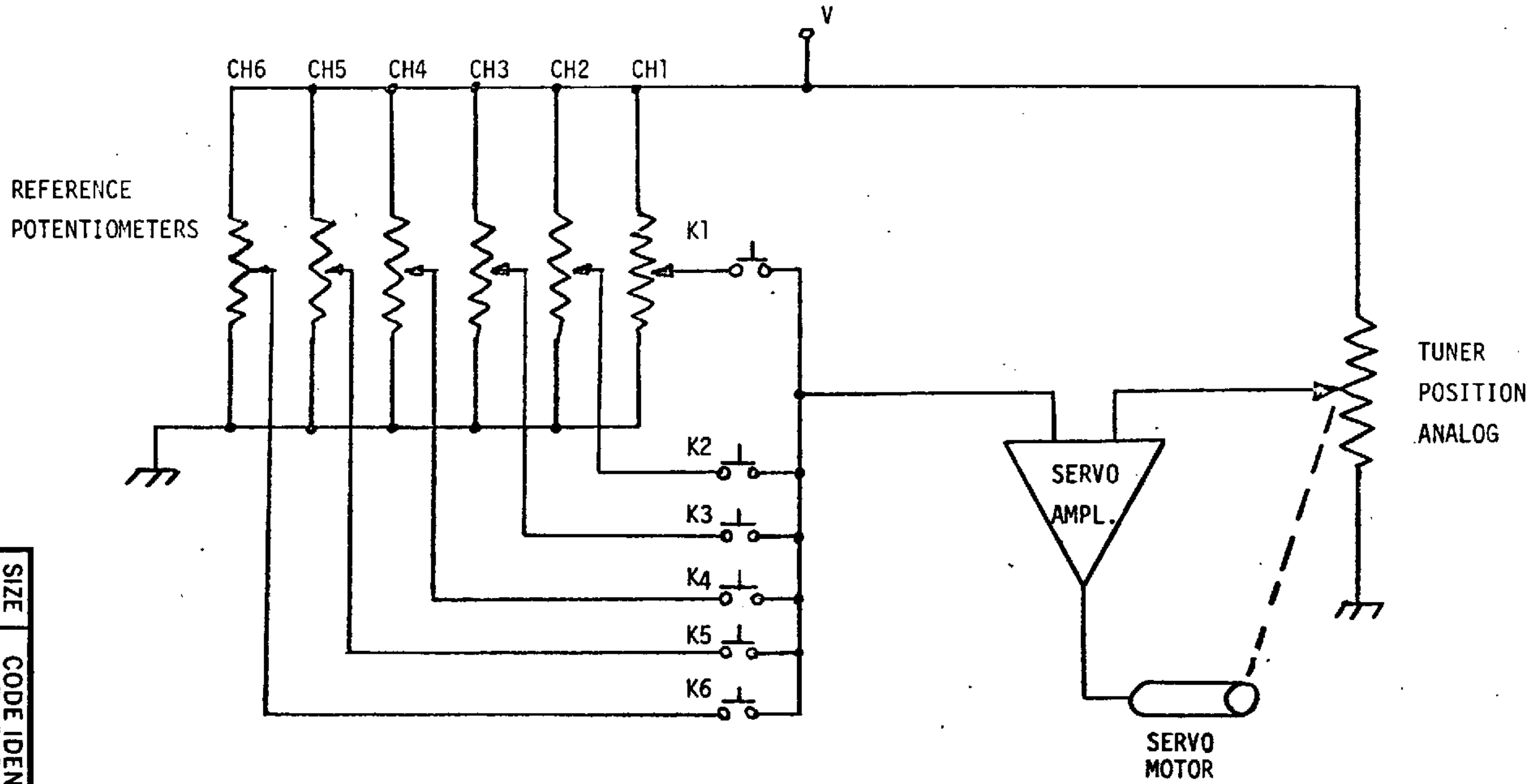
3.3 (ALL SUB-PARAGRAPHS)

5.0 PREPARATION FOR DELIVERY

THE UNITS SHALL BE PACKAGED IN A MANNER TO PREVENT DAMAGE DURING NORMAL SHIPPING AND HANDLING.

6.0 NOTES

NONE



NOTES: 1) DIAGRAM IS TYPICAL - 1 REQUIRED PER CAVITY

2) EACH CHANNEL SELECT RELAY - (K1 - K6) HAS SEPARATE CONTACTS FOR EACH CAVITY.

FIGURE 1 - BLOCK DIAGRAM - STEP TUNER CONCEPT

SIZE	CODE IDENT	DWG NO.
A	13499	090-0047-257

SCALE | REV | SHEET 7

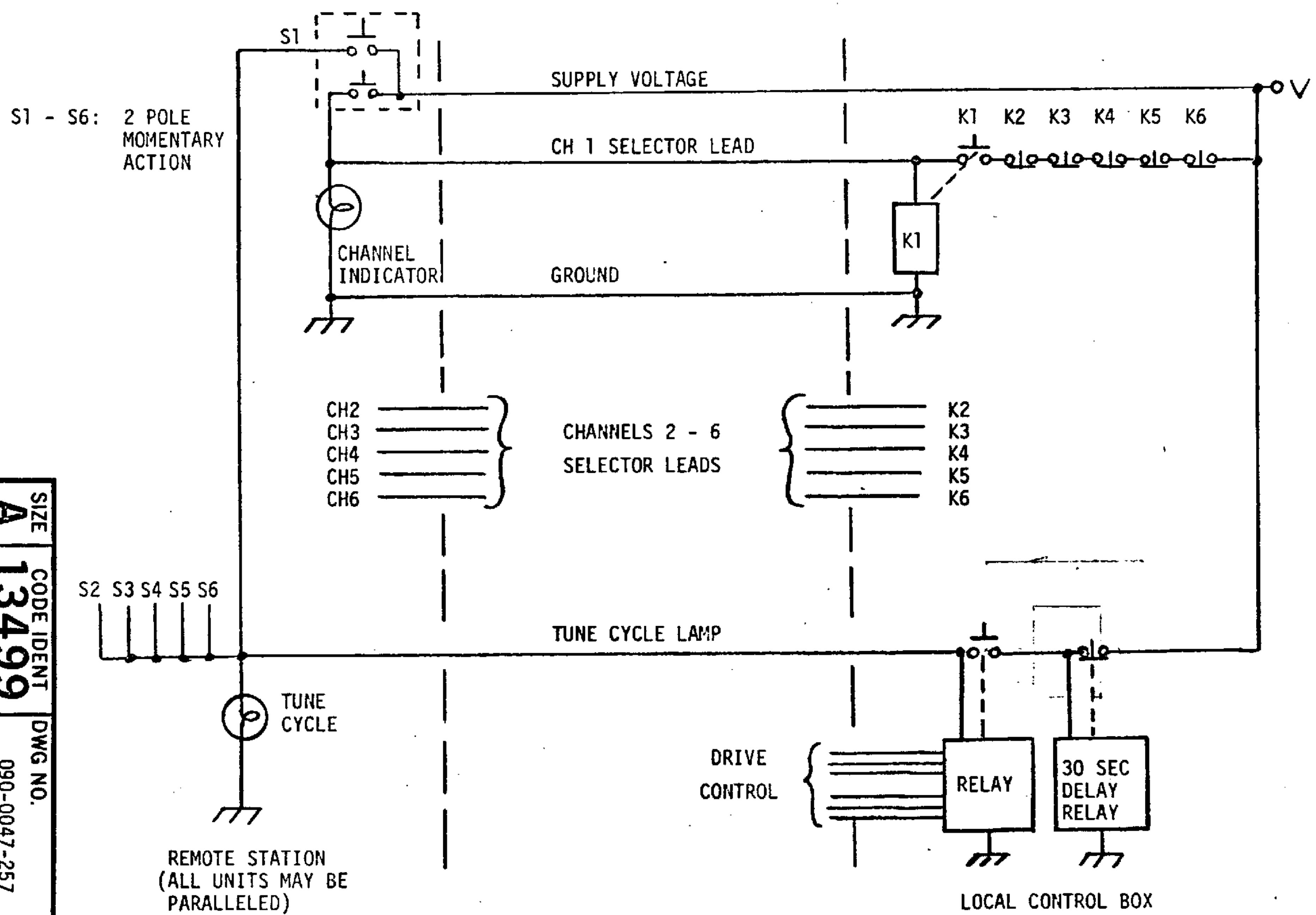


FIGURE 2 - RECOMMENDED CONTROL CIRCUITRY

SIZE	A
CODE IDENT	13499
DWG NO.	090-0047-257
SCALE	
REV	
SHEET	8

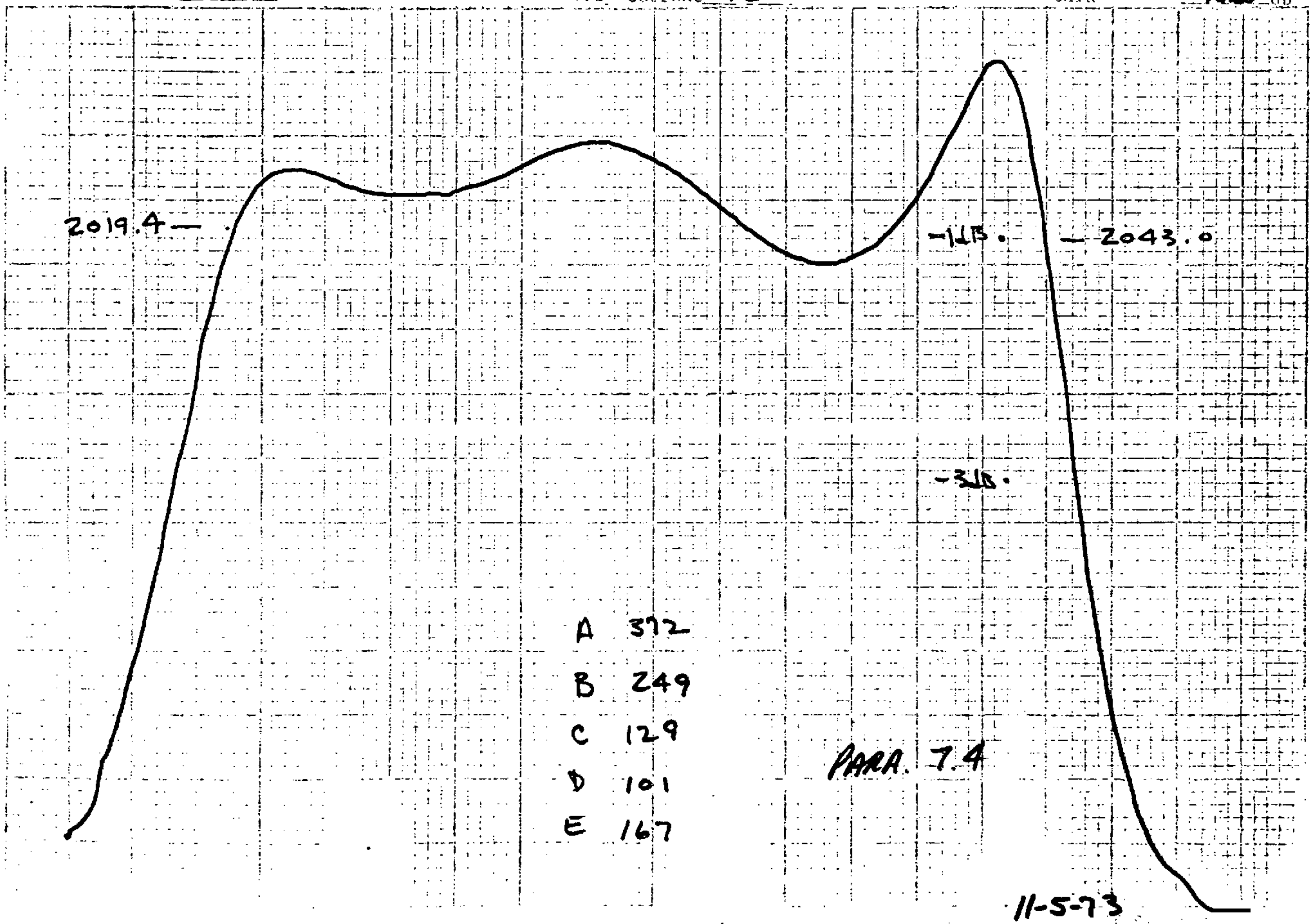
DESCRIPTION OR INCLUDED GRAPHS

Date	Description
11-5-73) 11-6-73)- 11-7-73)	Official Test Per Paragraphs 7.4 and 7.7 of 607-4319-001
11-30-73	Re-Test of Repeatability of Channels 1-6 at Powers Levels of 1 and 20 KW
12-3-73	Passband Response of Channels 1-6 at Power Levels of 2 and 10 KW
12-4-73	Six Repeat Runs of Channel 6 at 20 KW To Check Repeatability of Tuning.

Freq 2031 MHz
Filament voltage 7.5 V
Filament current 10.2 A
Magnet current 17.5 A

Channel 1
Beam voltage 21.0 kV
Beam current 2.5 A
Body current 12 mA

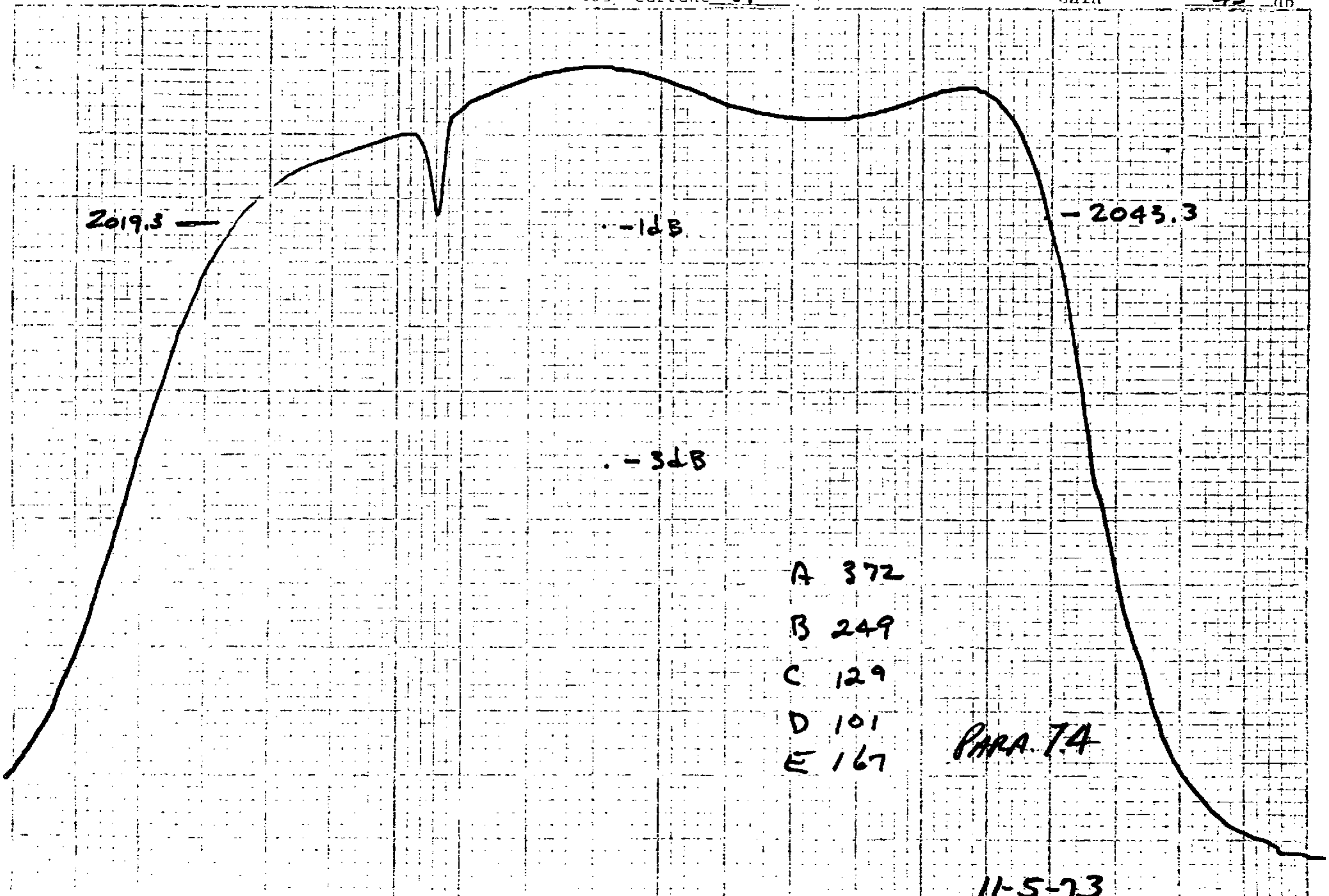
Date 11-5-[redacted] /HRC
Power output 1 Kw kW
Drive power 37 mW
Gain [illegible] db



Freq 2031 MHz
Filament voltage 7.5 V
Filament current 10.2 A
Magnet current 17.5 A

Channel 1
Beam voltage 21.0 kV
Beam current 2.5 A
Body current 81 mA

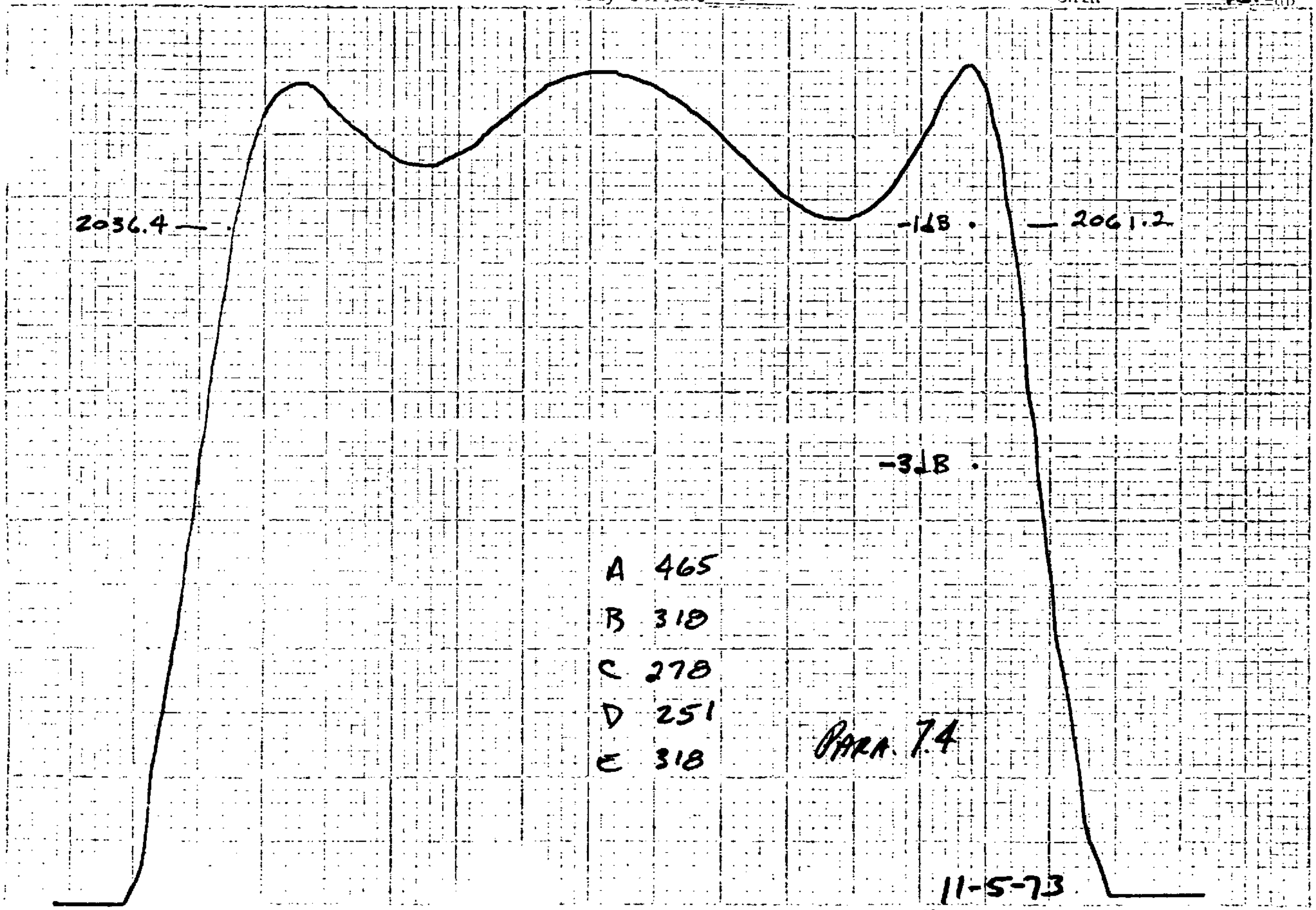
Date 11-5 by HRC
Power output 20 kW
Drive power 1000 mW
Gain 43 db



Freq — 2048 MHz
Filament voltage 7.5 V
Filament current 10.2 A
Magnet current 17.5 A

Channel 2
Beam voltage 21.0 kV
Beam current 2.5 A
Body current 12 mA

Date 11-5-73, HRC
Power output 1 Kw
Drive power 24 mW
Gain 46.2 db



2048

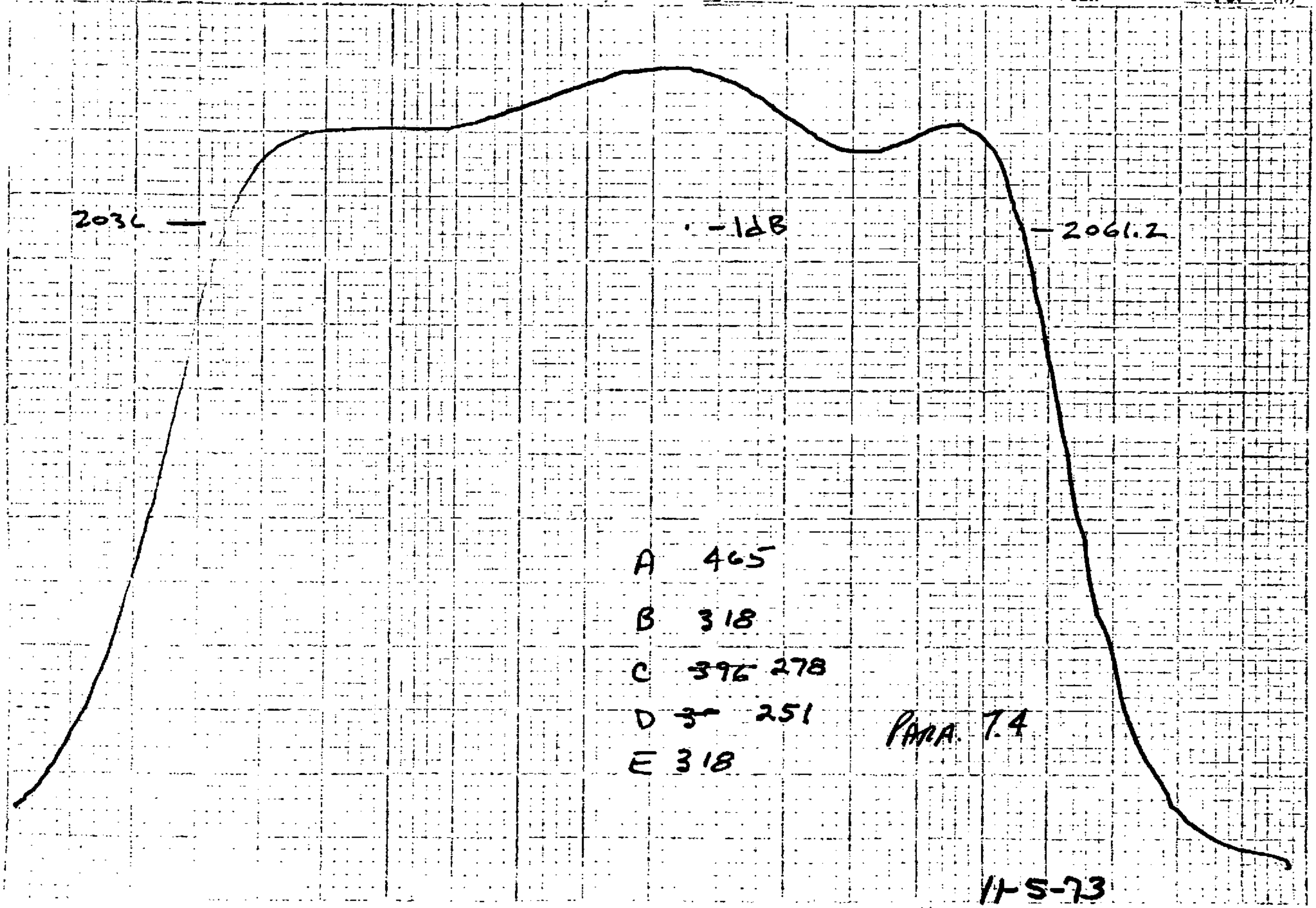
Filament voltage 7.5 V
Filament current 10.2 A
Magnet current 17.5 A

2

Beam voltage 21.0 kV
Beam current 2.5 A
Body current 38 mA

Date 11-5 HRe

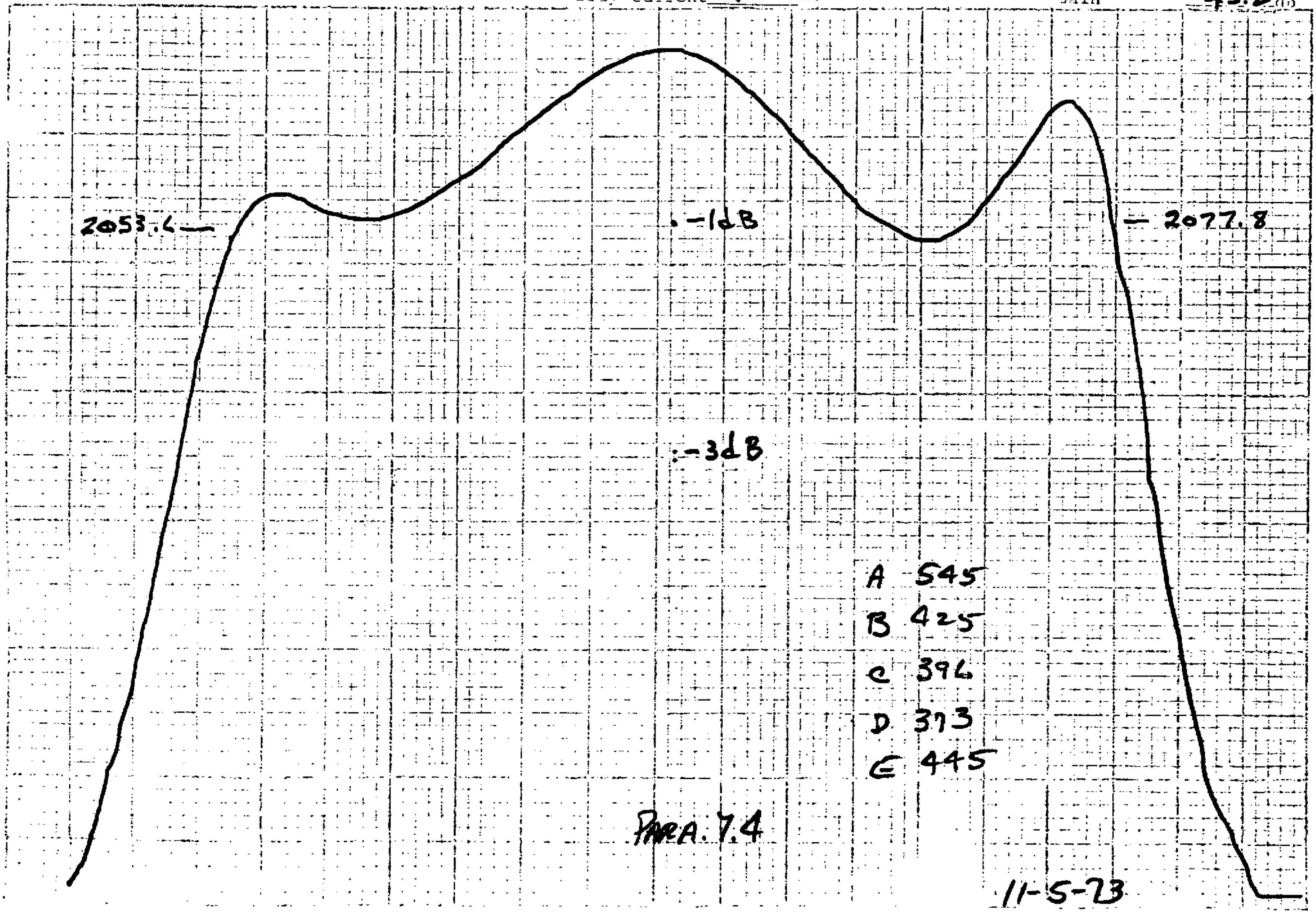
Power output 20 kW
Drive power 850 mW
Gain 43.7 db



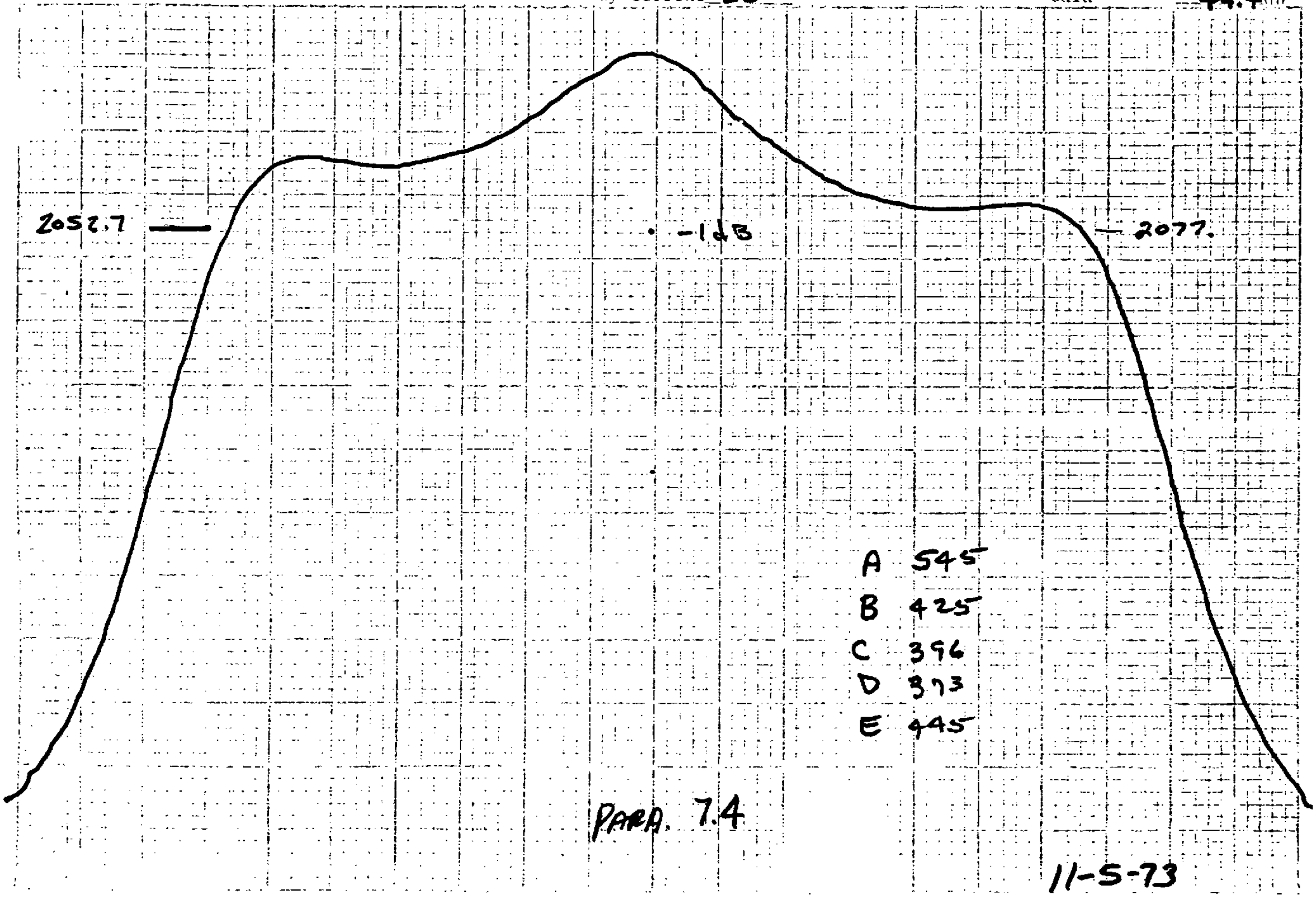
Freq 2065 MHz
Filament voltage 7.5 V
Filament current 10.2 A
Magnet current 17.5 A

Channel 3
Beam voltage 20.0 kV
Beam current 2.3 A
Body current 12 mA

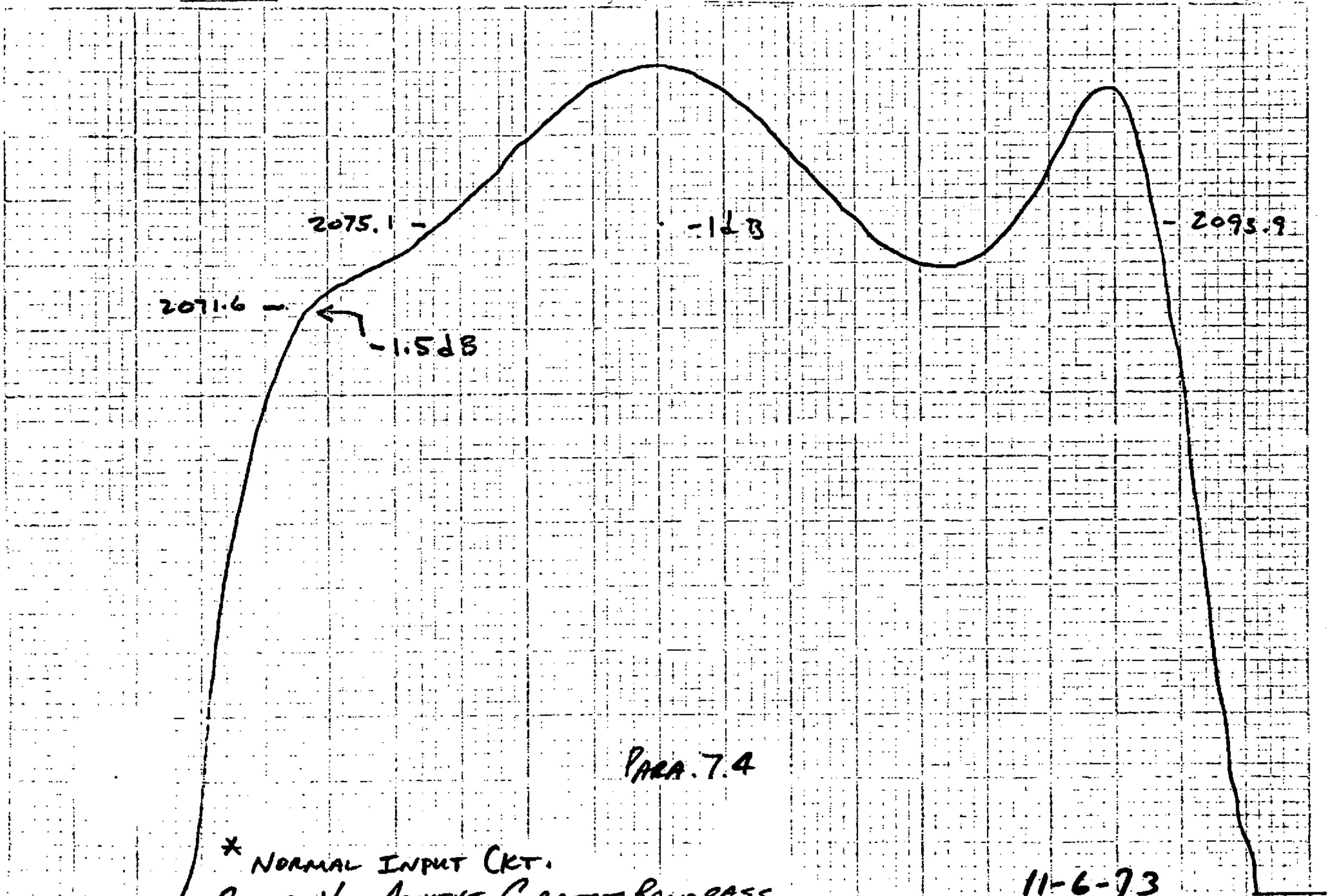
Date 11-5-[illegible] HRC
Power output 1 KW kW
Drive power 30 mW
Gain 45.2 db



[illegible] 2065 [illegible]	Channel 3	Date 11-5[illegible]3 By HRC
Filament voltage 7.5 V	Beam voltage 21.0 kV	Power output 20 kW
Filament current 10.2 A	Beam current 2.5 A	Drive power 720 mW
Magnet current 17.5 A	Body current 28 mA	Gain 44.4 db



Freq 2082 MHz	Channel 4	Date 11-6-● HRC
Filament voltage 7.5 V	Beam voltage 20.5 kV	Power output 1.0 kW
Filament current 10.2 A	Beam current ____ A	Drive power ____ W
Magnet current 17.5 A	Body current ____ mA	Gain ____ db



Para. 7.4

* Normal Input Ckt.
Could Not Achieve Correct Bandpass

11-6-73

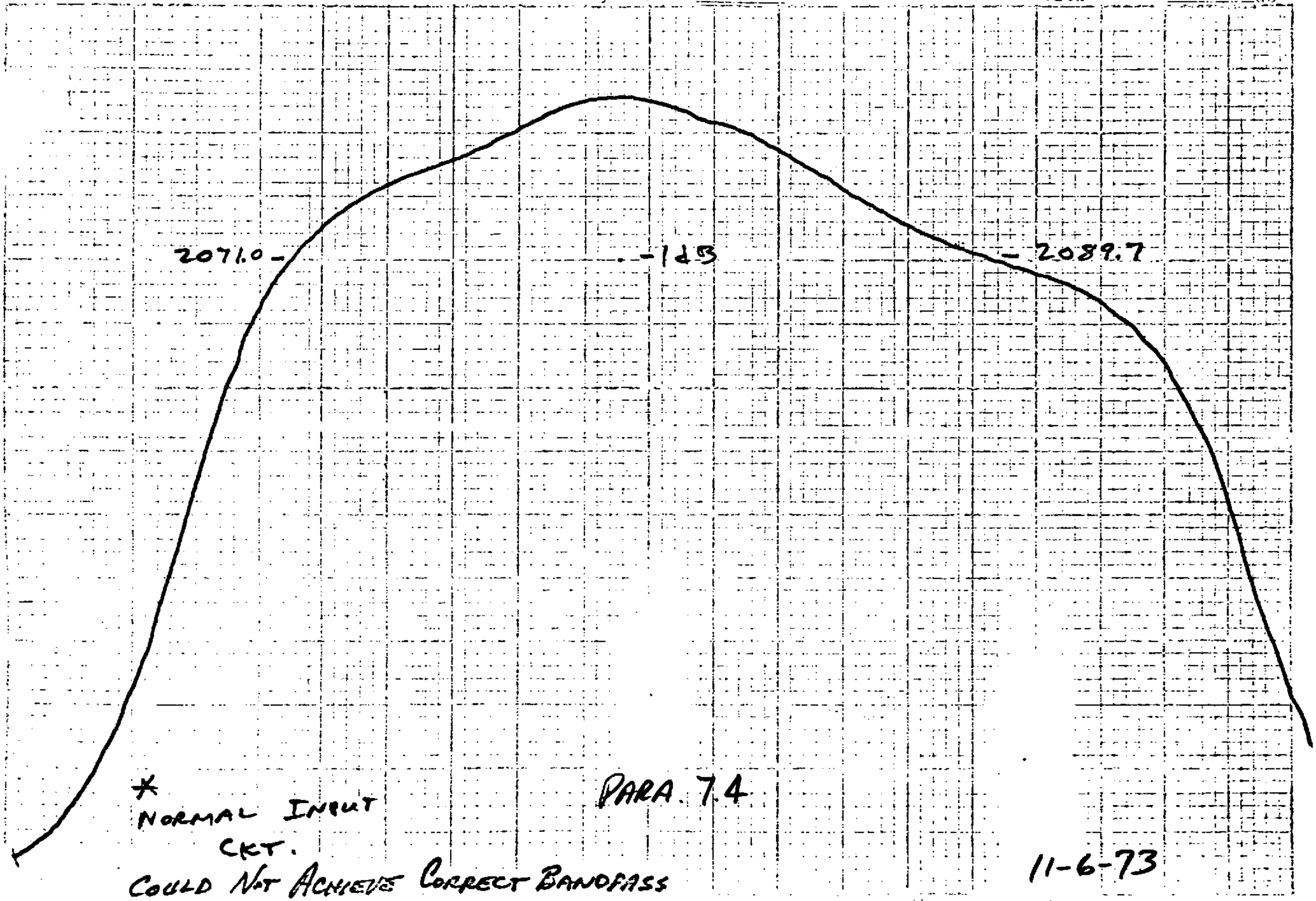
11-6 HRC

2082

Filament voltage 7.5 V
Filament current 10.2 A
Magnet current 17.5 A

Channel 4
Beam voltage 20.5 kV
Beam current 2.4 A
Body current ______ mA

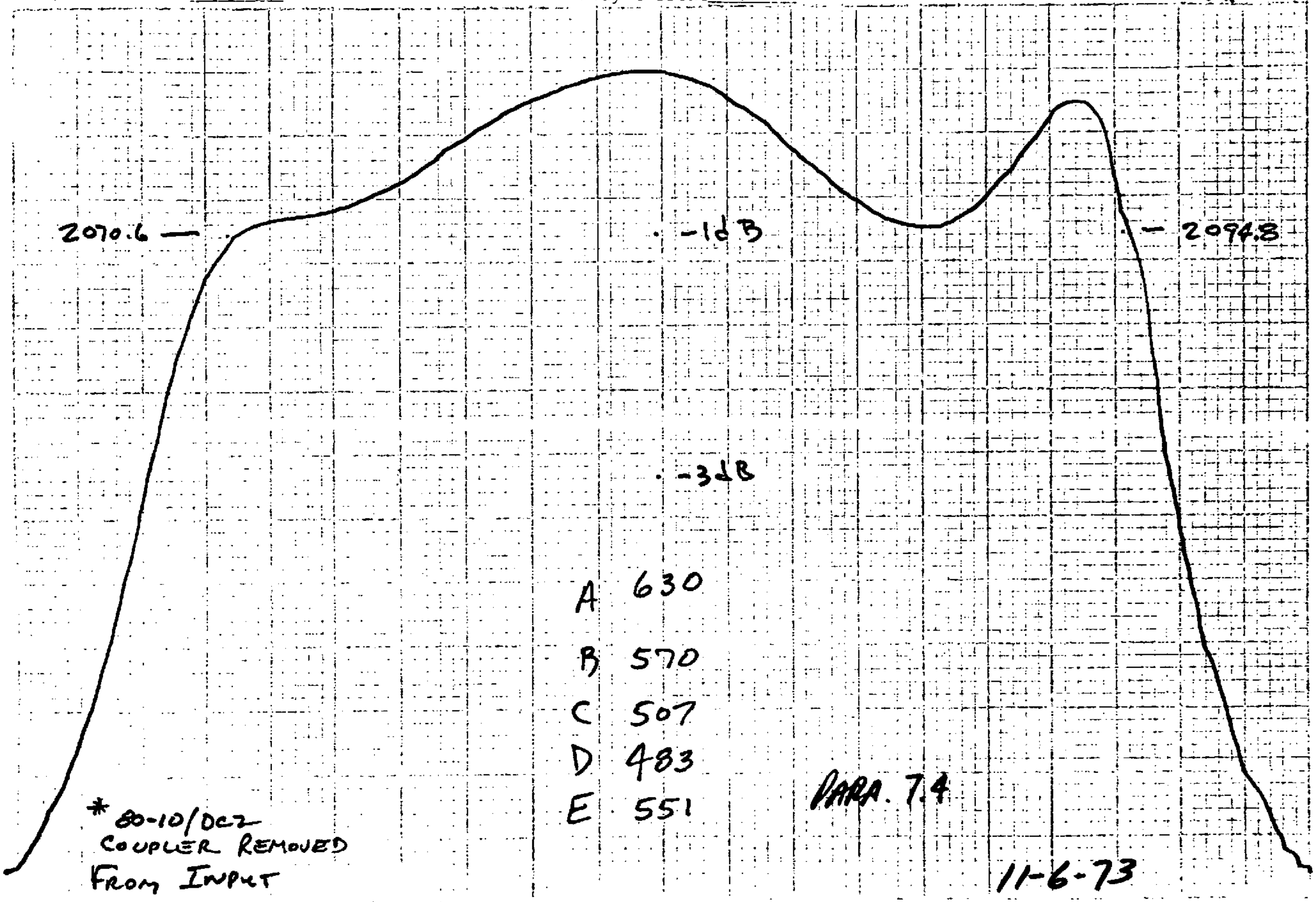
Power output 20 kW
Drive power ______ mW
Gain ______ db



Freq 2082 MHz
Filament voltage 7.5 V
Filament current 11.2 A
Magnet current 17.5 A

Channel 4
Beam voltage 20.5 kV
Beam current 2.4 A
Body current 10 mA

Date 11-6 3 HRC
Power output 1.0 kW
Drive power 40 W
Gain 44.0 dB

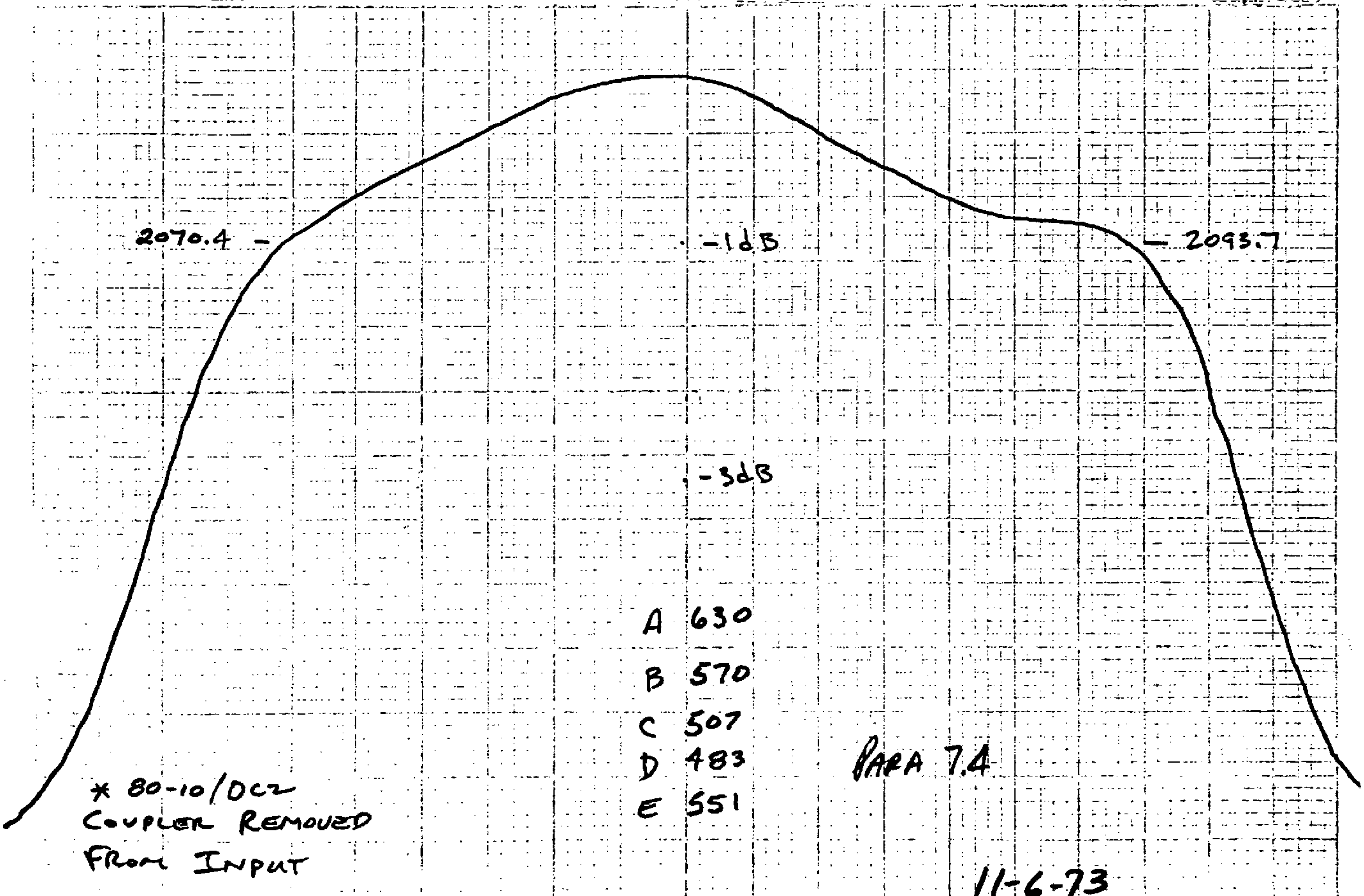


11-6- HRC

2082 MHz
Filament voltage 7.5 V
Filament current 10.2 A
Magnet current 17.5 A

A
Beam voltage 20.5 kV
Beam current 2.4 A
Body current 21 mA

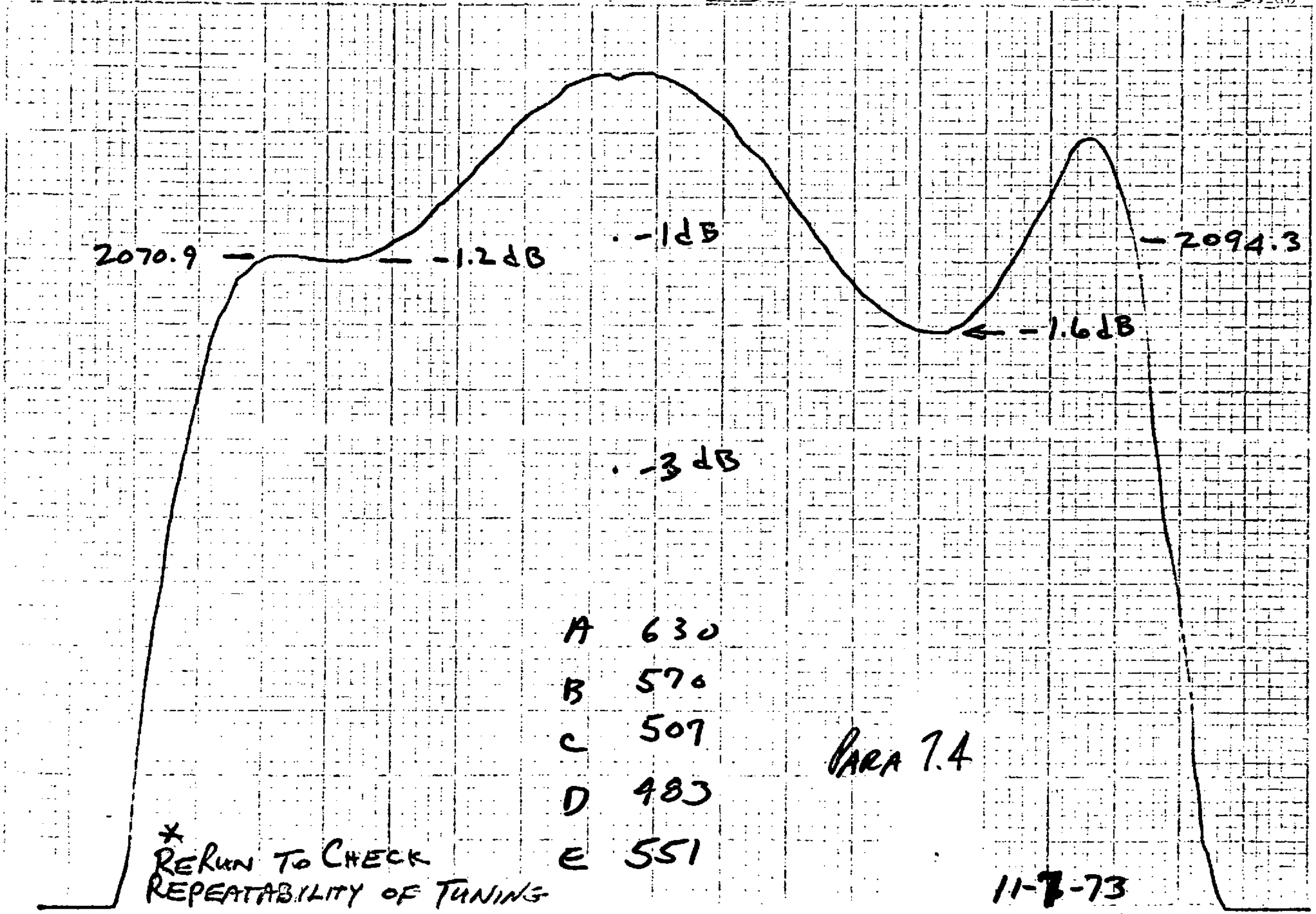
Power output 20.0 kW
Drive power 1320 W
Gain 41.8 db



[illegible] 2082 Hz
Filament voltage 7.5 V
Filament current 10.2 A
Magnet current 17.5 A

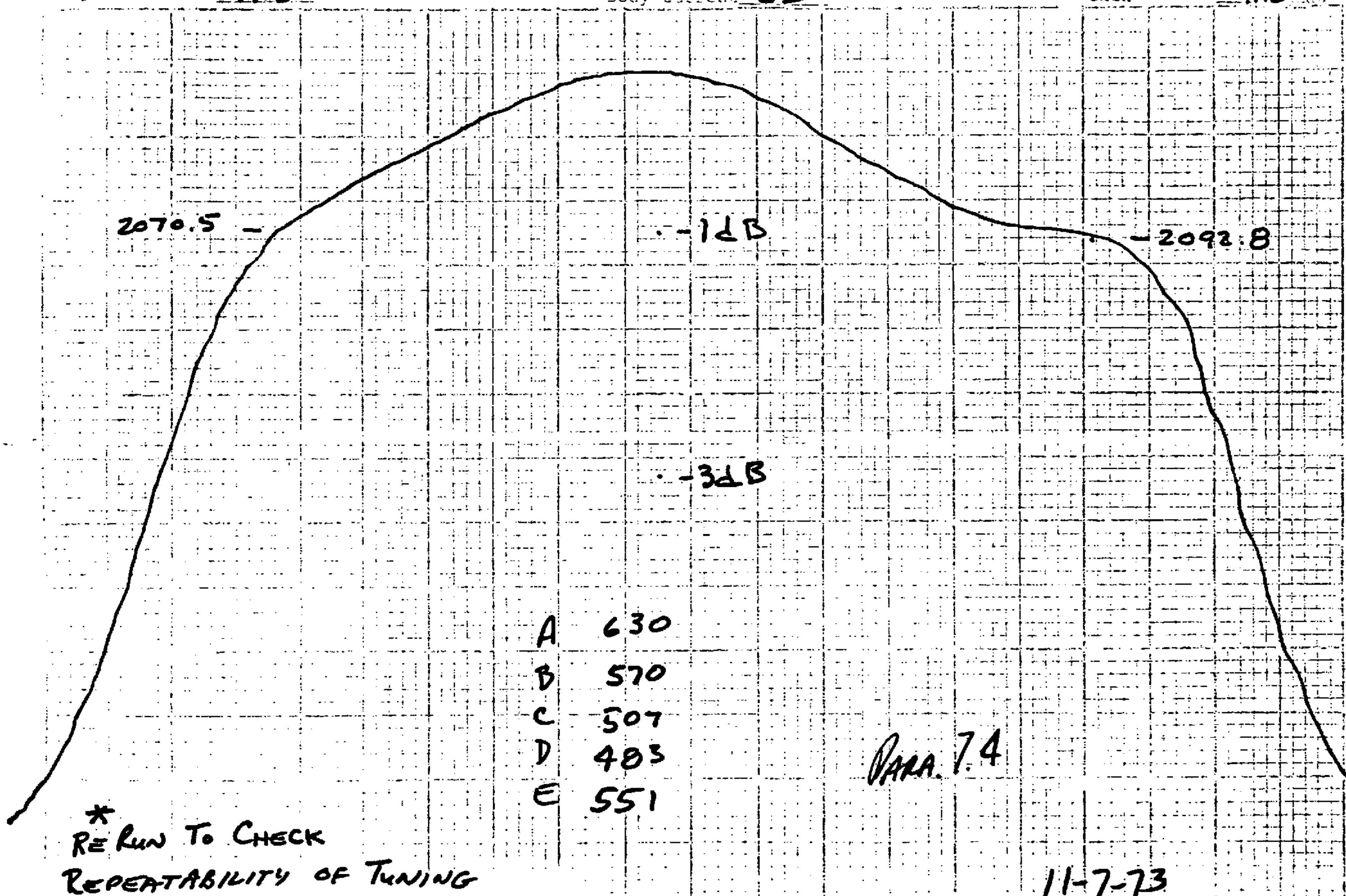
Channel 4
Beam voltage 20.5 kV
Beam current 2.4 A
Body current 13 mA

Date 11-[illegible]-73 HRC
Power output 1 kW
Drive power 36 W
Gain 44.4 db



11-7[illegible]3 HRe

TPI 2082	Channel 4	
Filament voltage 7.5 V	Beam voltage 20.5 kV	Power output 20 kW
Filament current 10.2 A	Beam current 2.4 A	Drive power 1320 W
Magnet current 17.5 A	Body current 22 mA	Gain 41.8 db



2099

Filament voltage 7.5

Filament current 10.2 A

Magnet current 17.5 A

Channel 5

Beam voltage 21.0 kV

Beam current 2.5 A

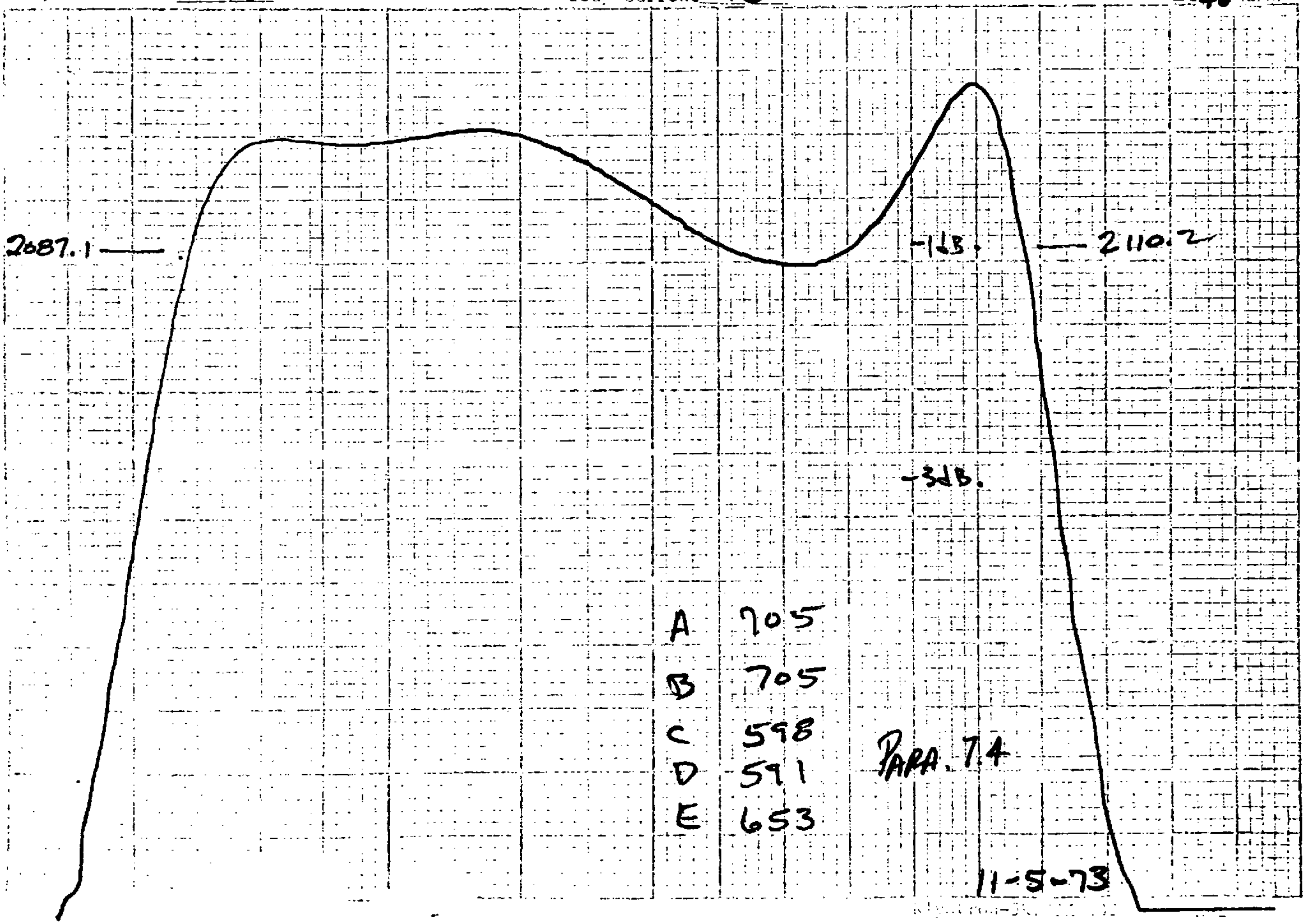
Body current 10 mA

11-5 HRC

Power output 1.0 kW

Drive power 25 mW

Gain 46 db

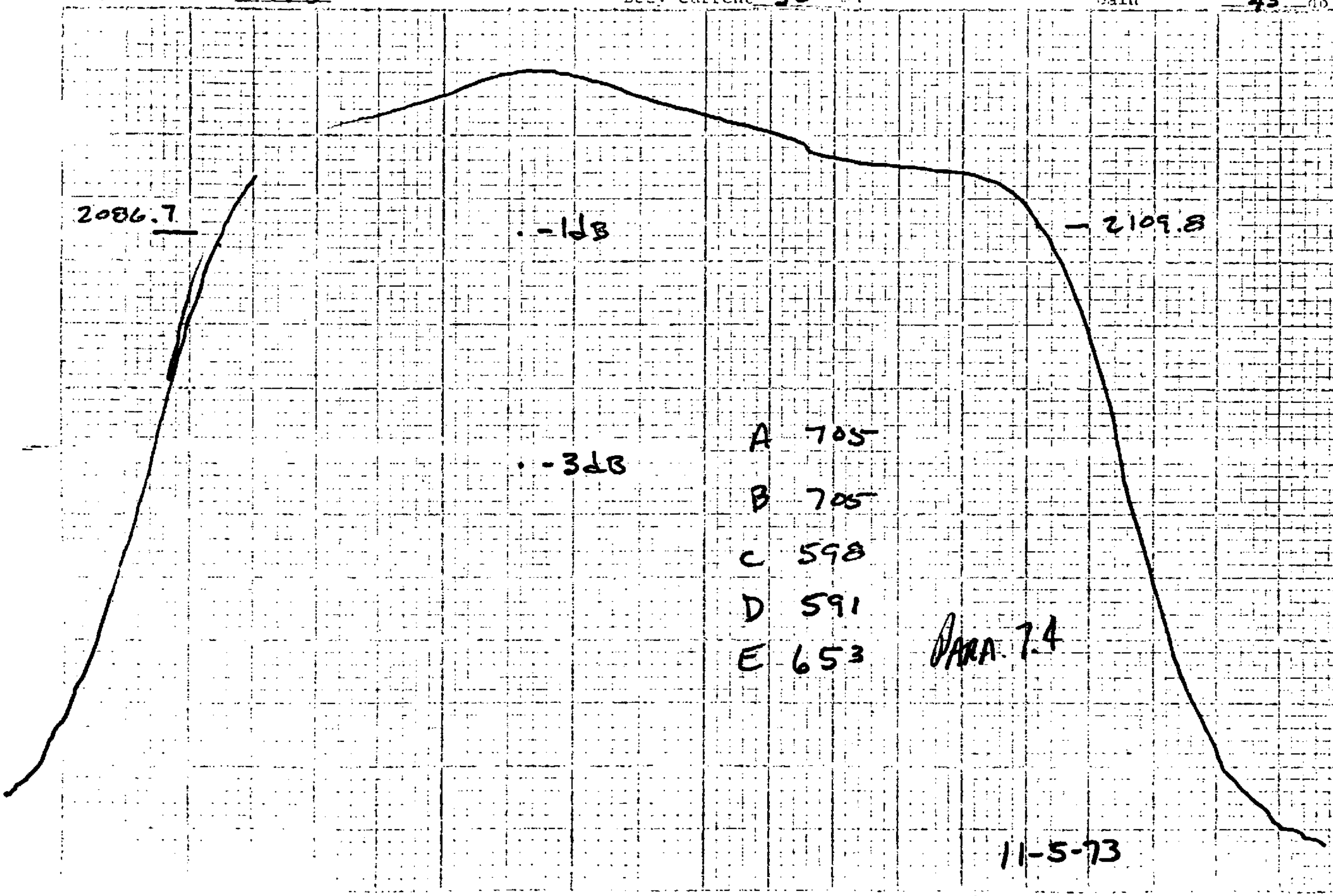


11-[illegible]73 HR

[illegible] 2099 MHz
Filament voltage 7.5 V
Filament current 10.2 A
Magnet current 17.5 A

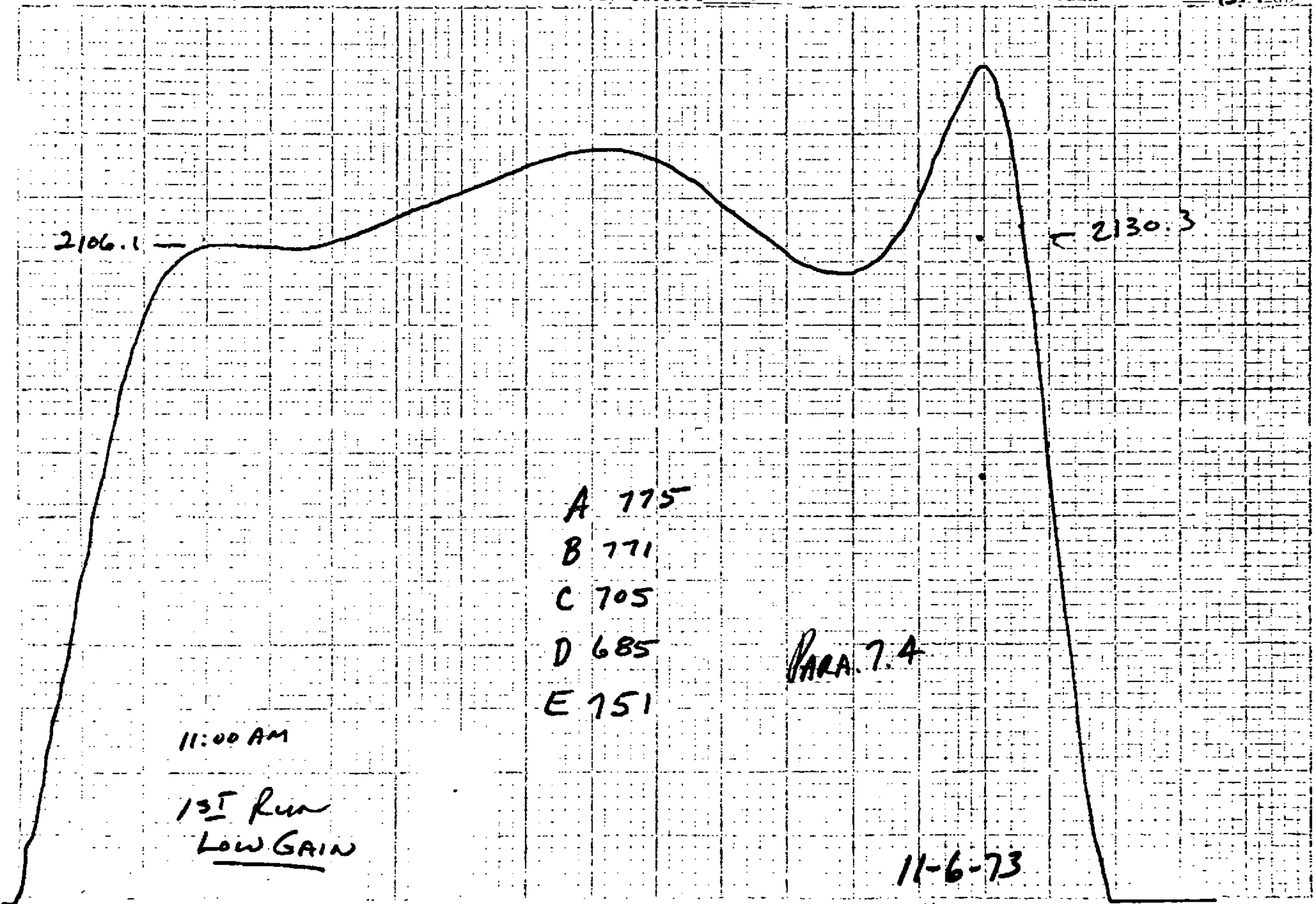
Channel 5
Beam voltage 21 kV
Beam current 2.5 A
Body current 30 mA

Power output 20.0 kW
Drive power 1000 mW
Gain 43 db



11-[illegible] HRC

2116 MHz	Channel 6	
Filament voltage 7.5 V	Beam voltage 20.5 kV	Power output 1 kW
Filament current 10.2 A	Beam current 2.5 A	Drive power 46 MW
Magnet current 17.5 A	Body current 10 mA	Gain 43.4 db



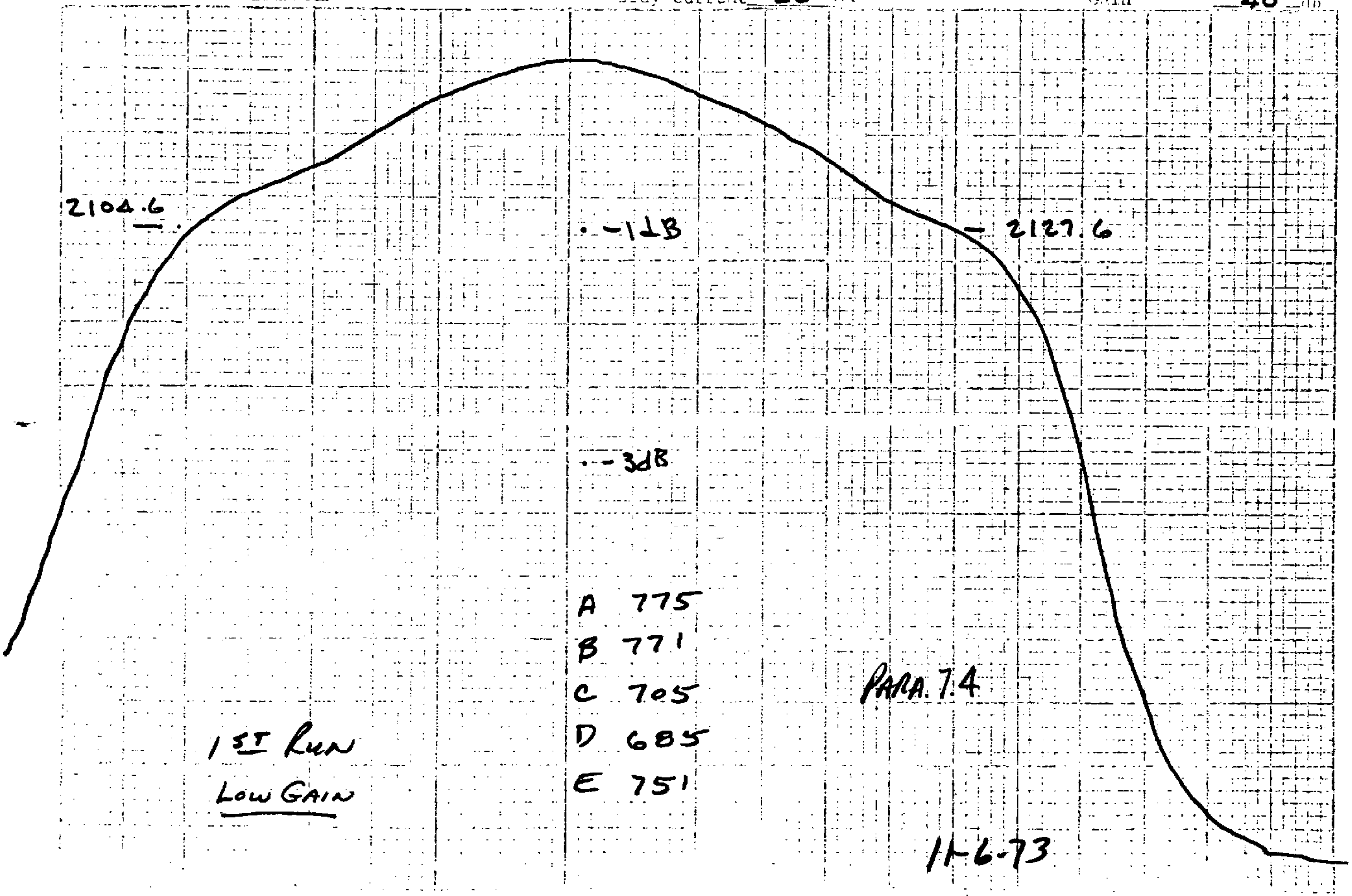
11-[illegible]73 HRC

2116

Filament voltage 7.5 V
Filament current 10.2 A
Magnet current 17.5 A

Channel 6
Beam voltage 20.5 kV
Beam current 2.4 A
Body current 20 mA

Power output 20 kW
Drive power 2000 mW
Gain 40 db



2116

Filament voltage 7.5 V

Filament current 10.2 A

Magnet current 17.5 A

Channel 6

Beam voltage 20.5 KV

Beam current 2.4 A

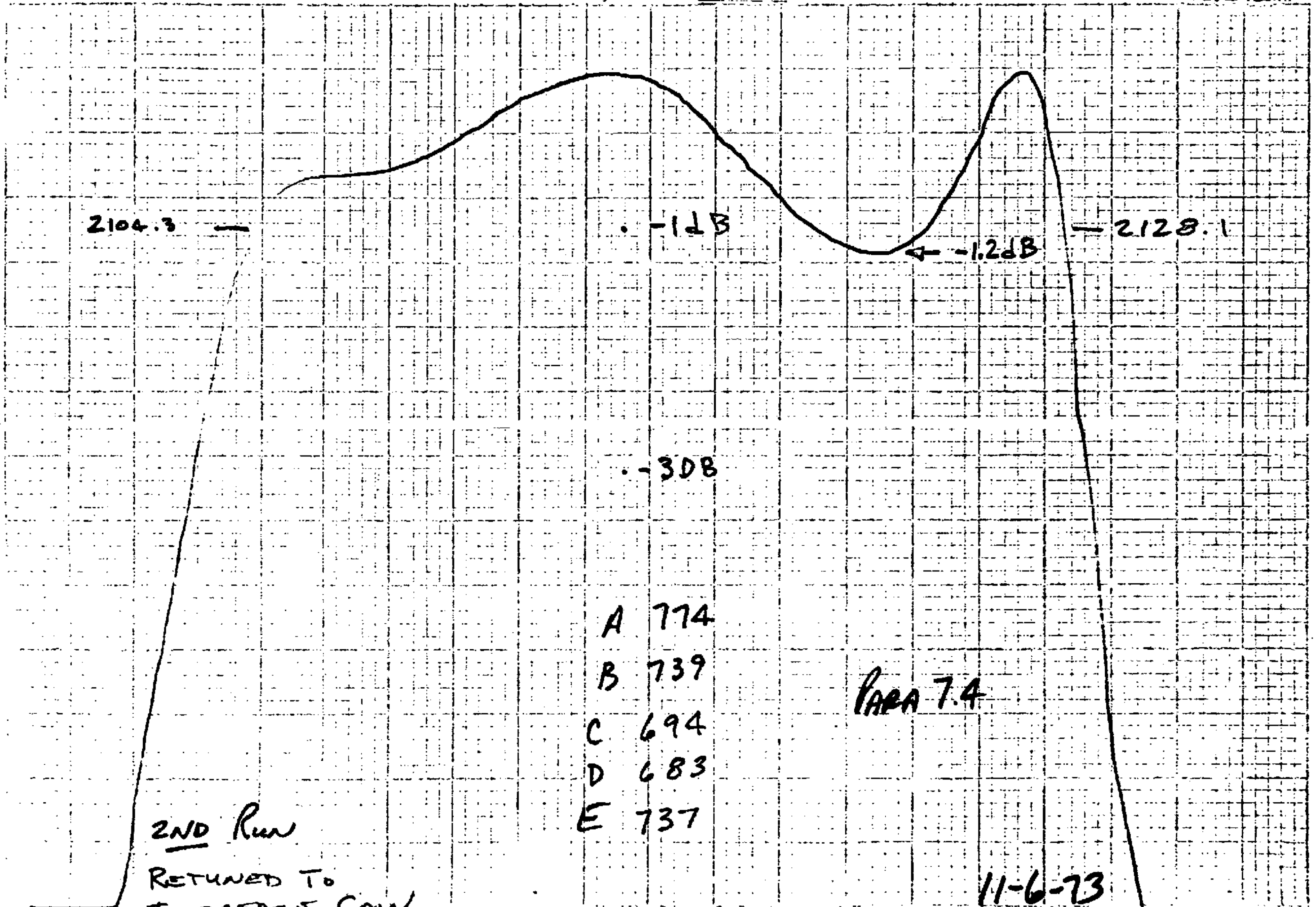
Body current 12 mA

Date 11-6 3 HRC

Power output 1 Kw

Drive power 28 mW

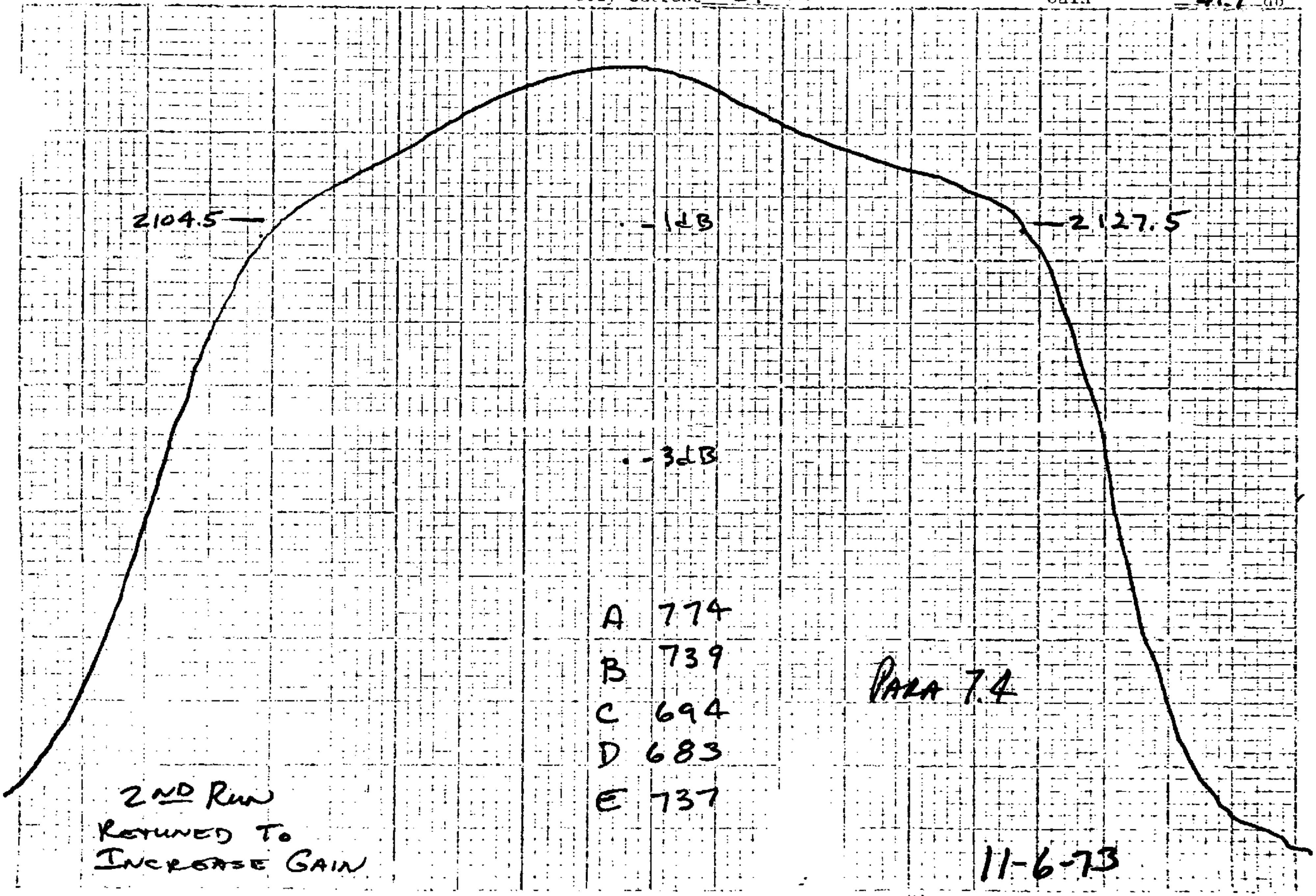
Gain 45.5 db



Freq 2116
Filament voltage 7.5
Filament current 10.2
Magnet current 17.5 A

Channel 6
Beam voltage 20.5 kV
Beam current 2.4 A
Body current 21 mA

Date 11-6- HRC
Power output 20 kW
Drive power 1280 mW
Gain 41.9 db



2065 MHz

Filament voltage ________ V

Filament current ________ A

Magnet current ________ A

3

Beam voltage 20.5 kV

Beam current ________ A

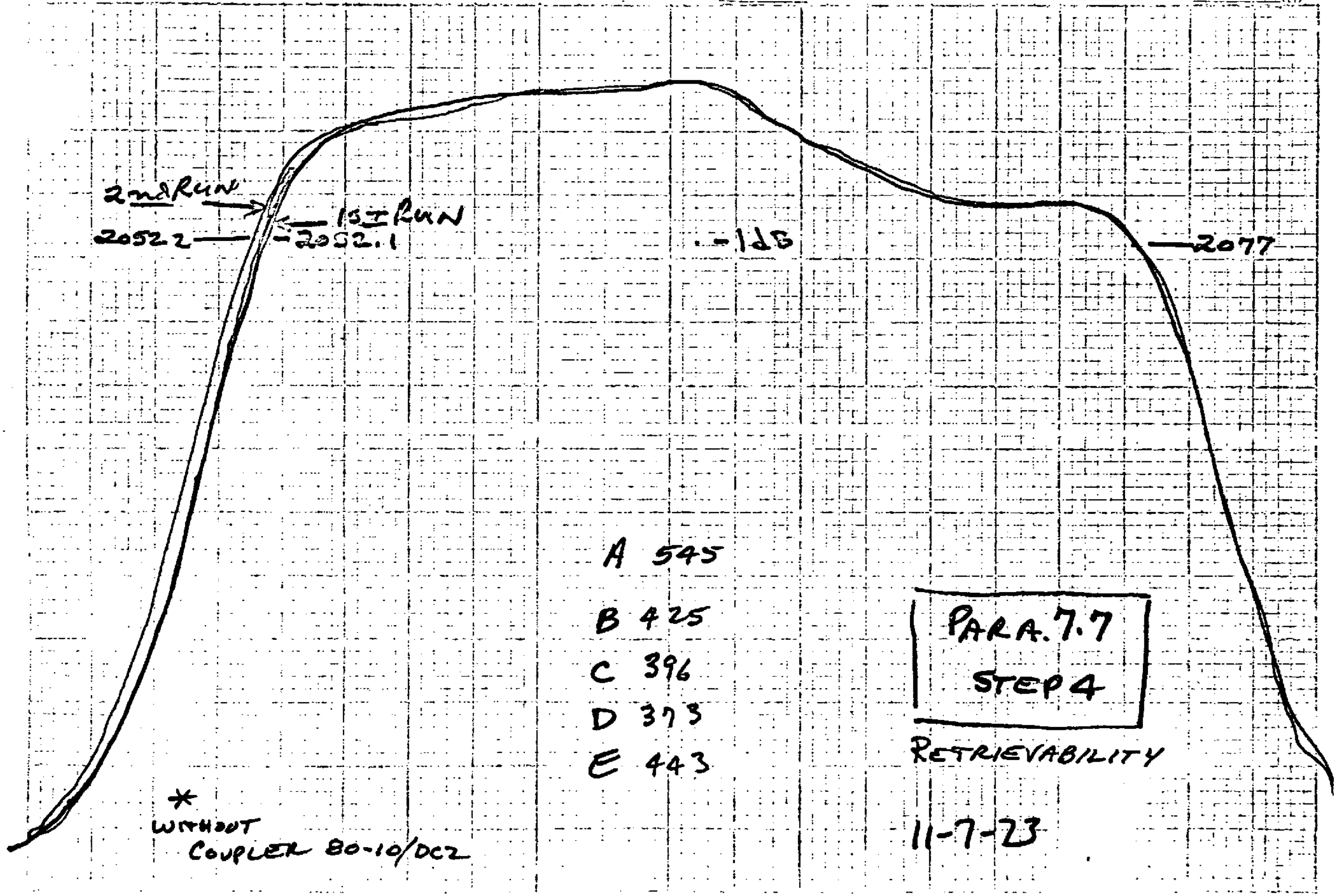
Body current ________ mA

11-[illegible]3 HRc

Power output 20 kW

Drive power ________ mW

Gain ________ db



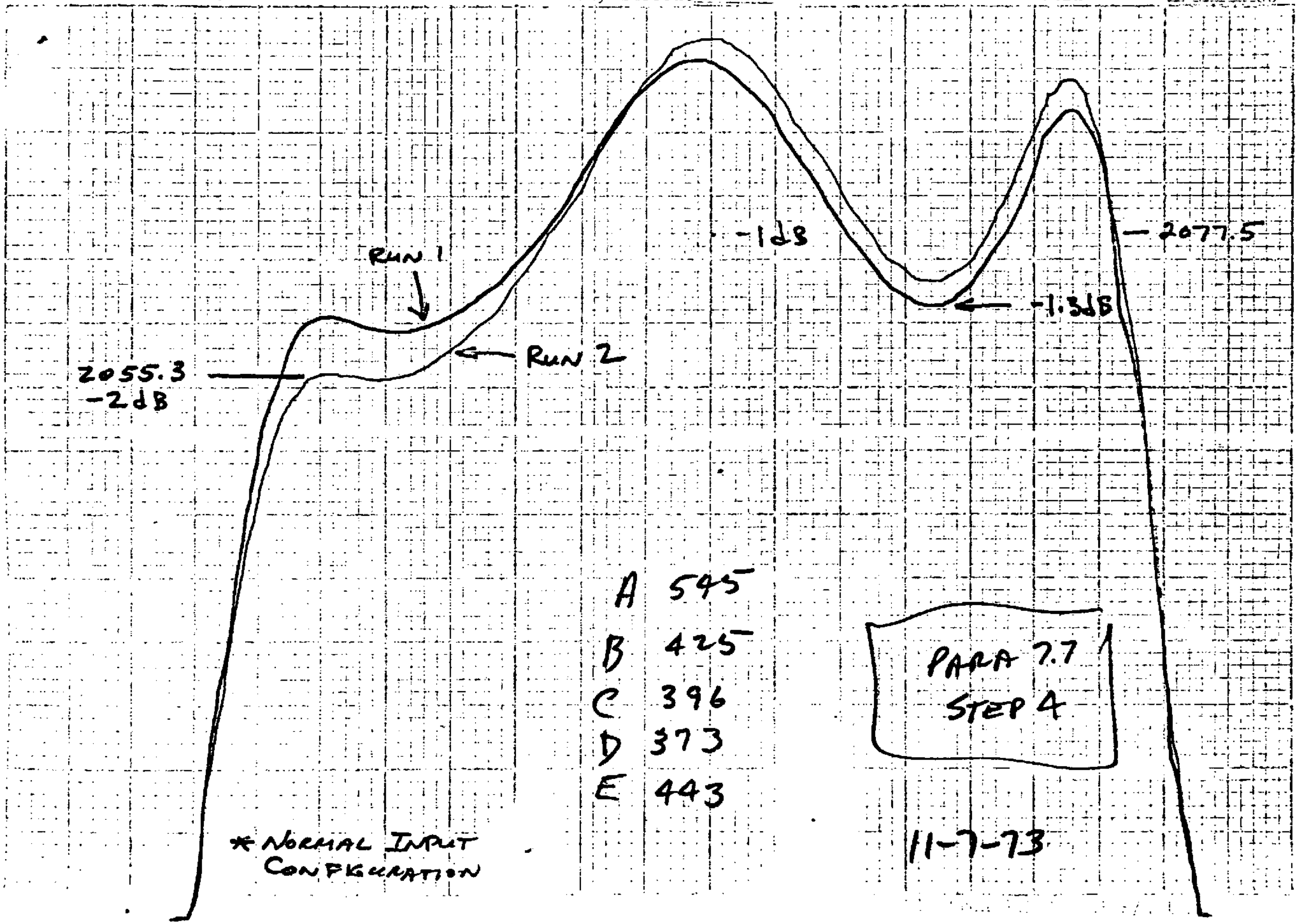
Filament current ______ A
Magnet current ______ A

3

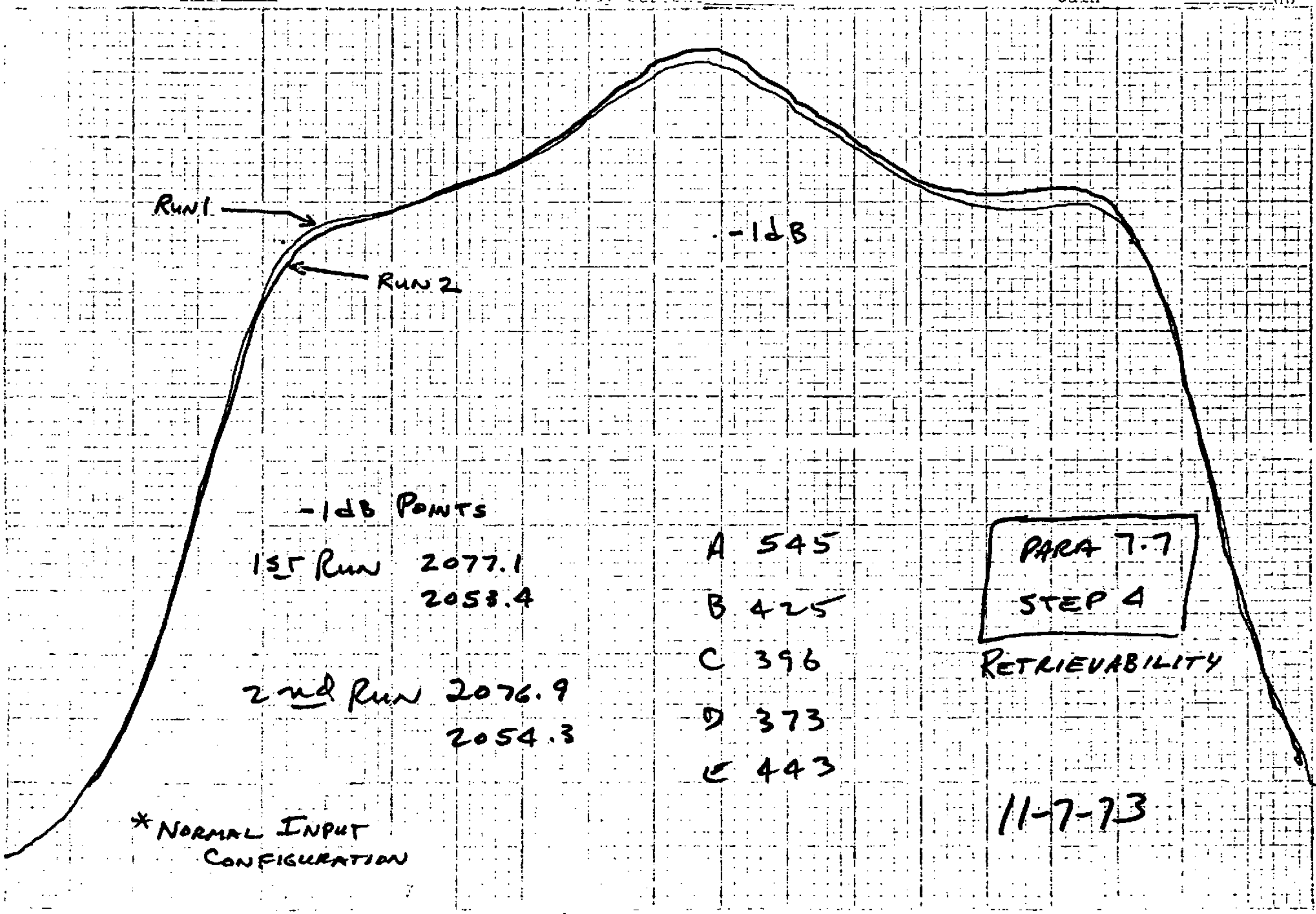
Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

11-7-● HRC

Power output 1 KW
Drive power ______ MW
Gain ______ db



2065 MHz	3	11-7[illegible]3 HRC
[illegible] voltage ______ V	Beam voltage ______ kV	Power output 20 kW
[illegible] current ______ A	Beam current ______ A	Drive power ______ MW
[illegible] current ______ A	Body current ______ mA	Gain ______ db



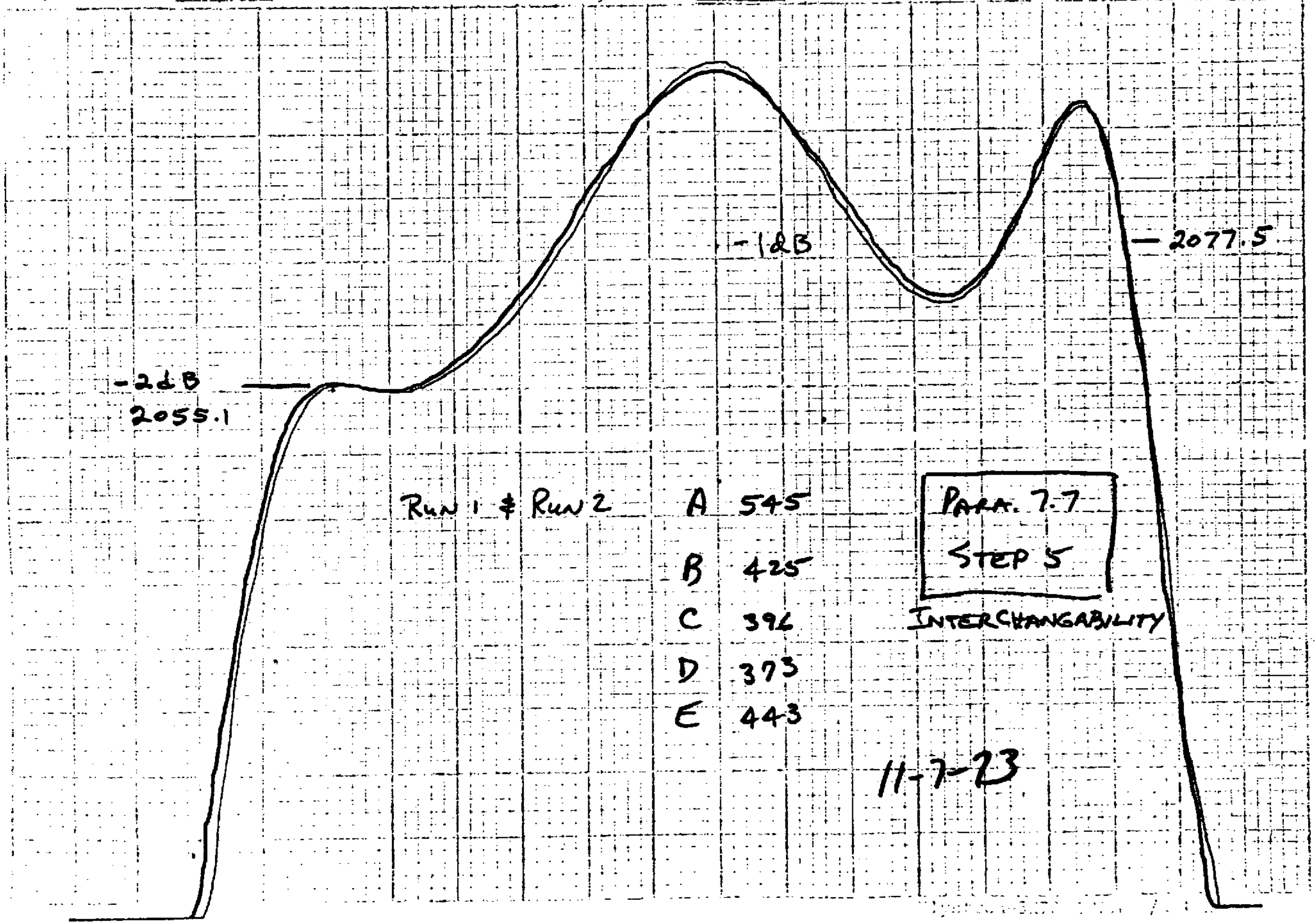
2065

Filament voltage 7.5 V
Filament current 10.2 A
Magnet current 17.5 A

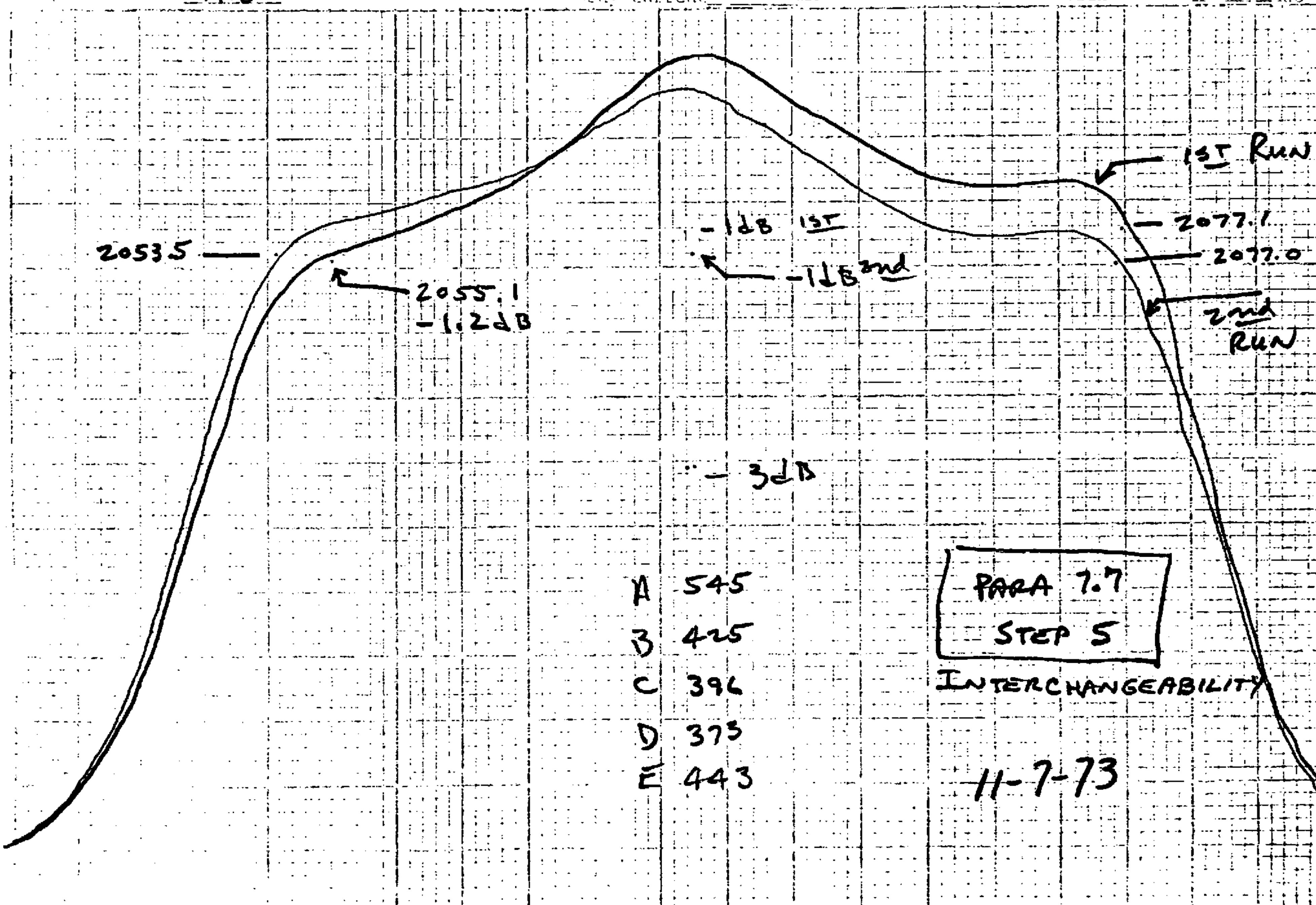
Channel 3
Beam voltage 20.5 kV
Beam current 2.4 A
Body current ______ mA

11-7-23 HRc

Power output 1 Kw
Drive power ______ MW
Gain ______ db



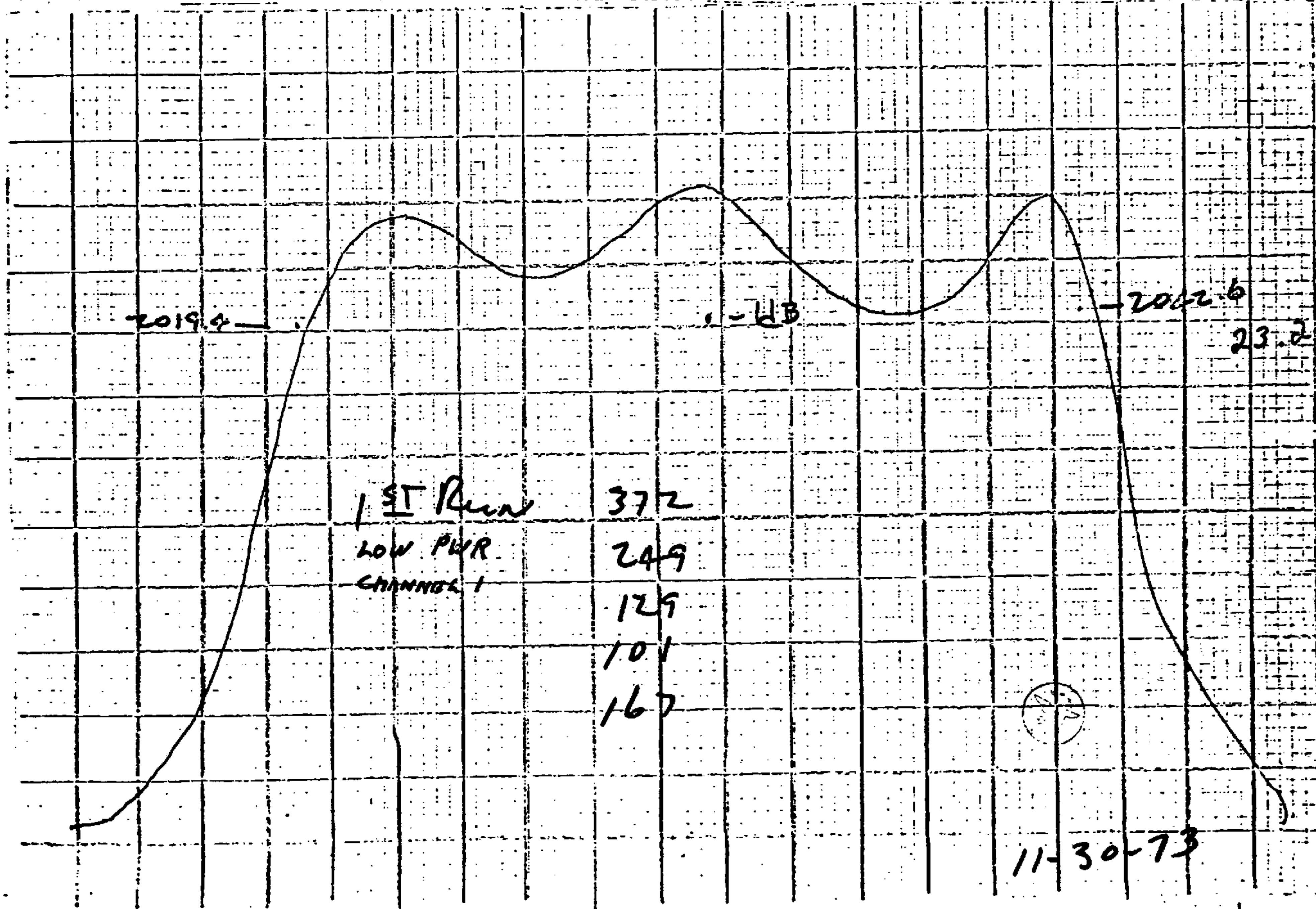
2065 MHz | Channel 3 | 11-[illegible]3 NRC
Heater voltage 7.5 V | Beam voltage 20.5 | Power output 20 kW
Filament current 10.2 A | Beam current 2.4 A | Drive power ______ mW
Magnet current 17.5 A | Body current ______ mA | Gain ______ db



___ MHz
Filament voltage ___ V
Filament current ___ A
Magnet current ___ A

1
Beam voltage ___ kV
Beam current ___ A
Body current ___ mA

Date 11-30-73
Power output 1 kW
Drive power ___ mW
Gain ___ db

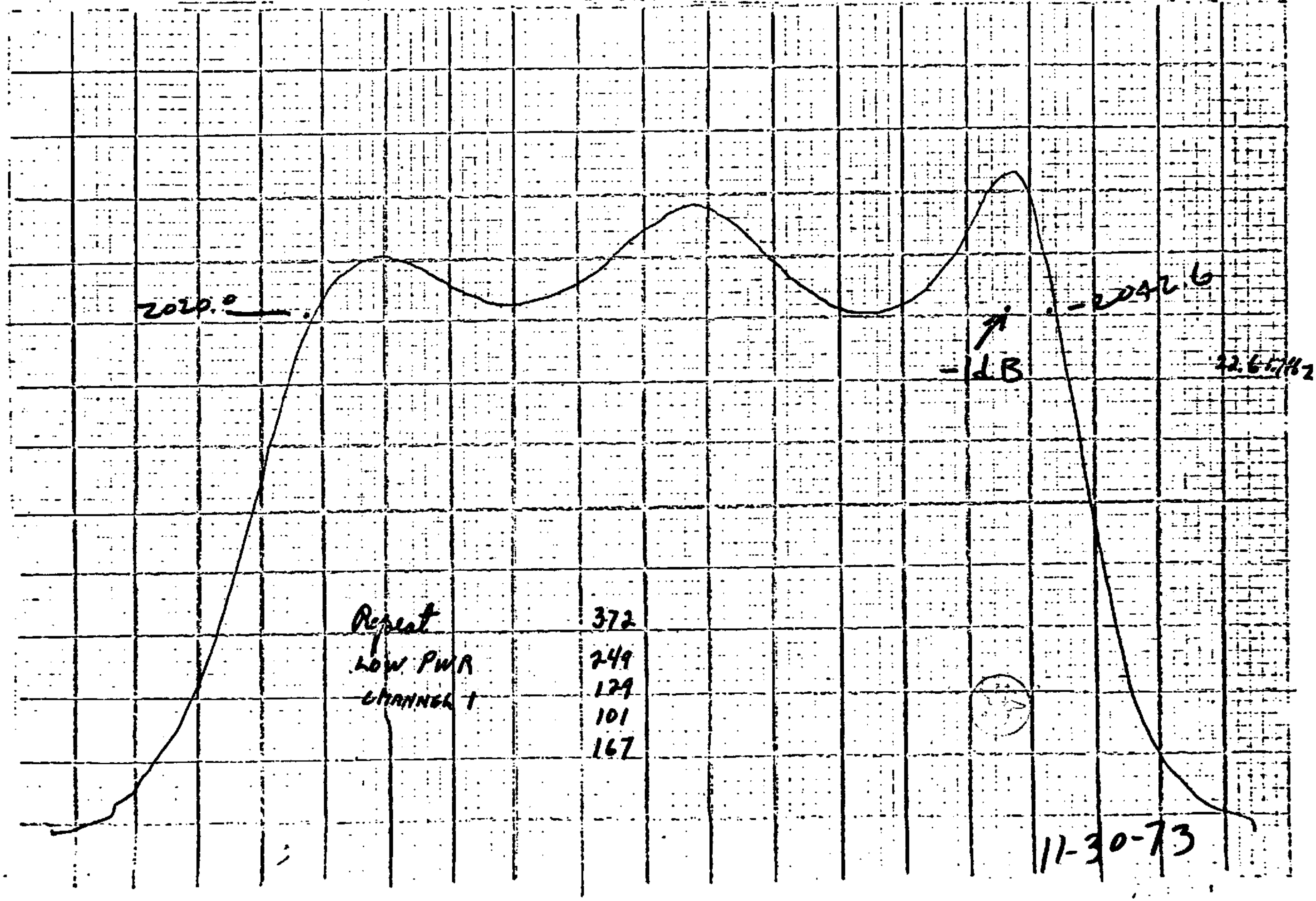


11-30

Filament voltage ______ V
Filament current ______ A
Magnet current ______ A

Beam voltage ___1___ kV
Beam current ______ A
Body current ______ mA

Power output ___1___ kW
Drive power ______ W
Gain ______ db



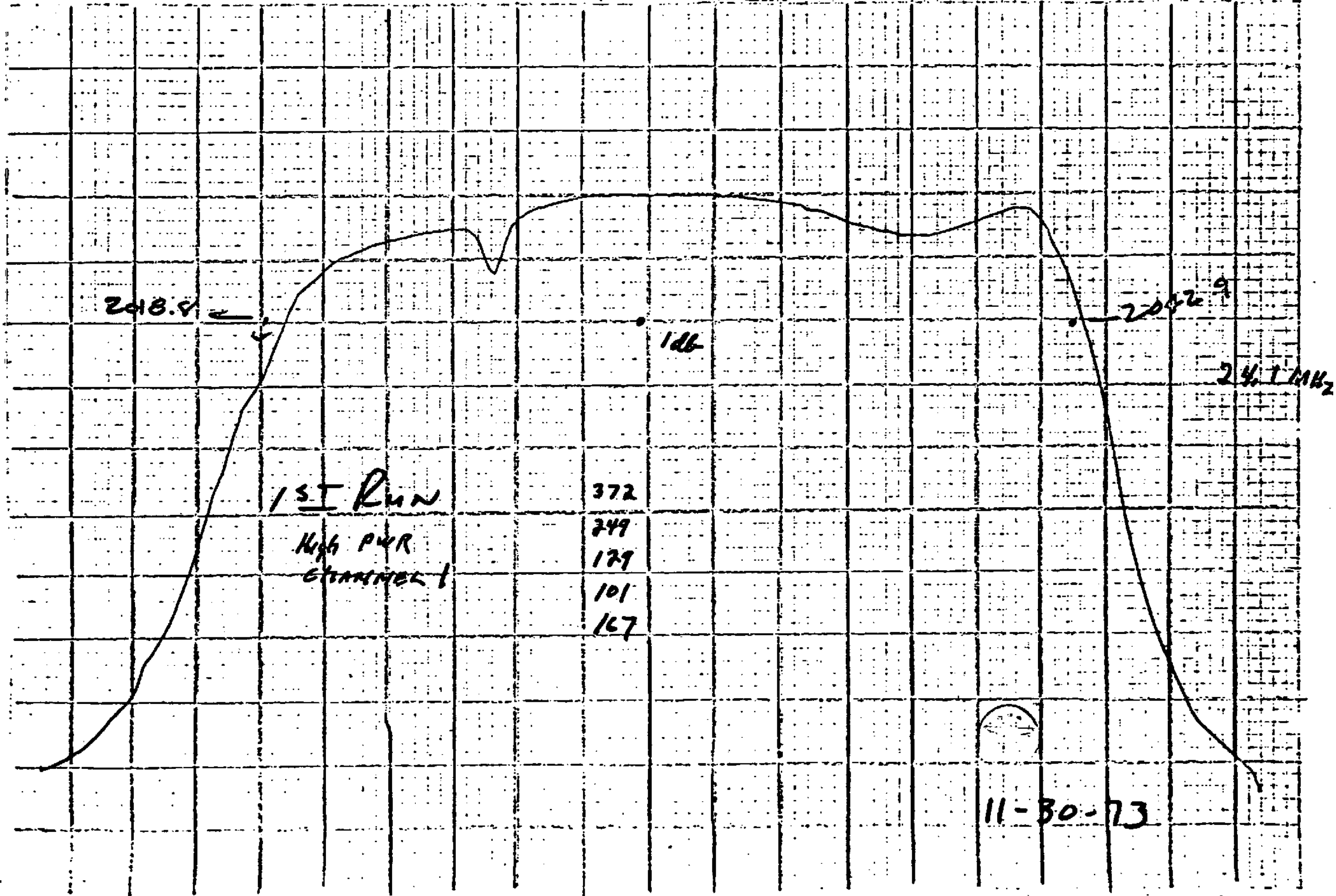
11-30-7

1

______ Mc
Filament voltage ______ V
Filament current ______ A
Magnet current ______ A

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 20 kW
Drive power ______ mW
Gain ______ db

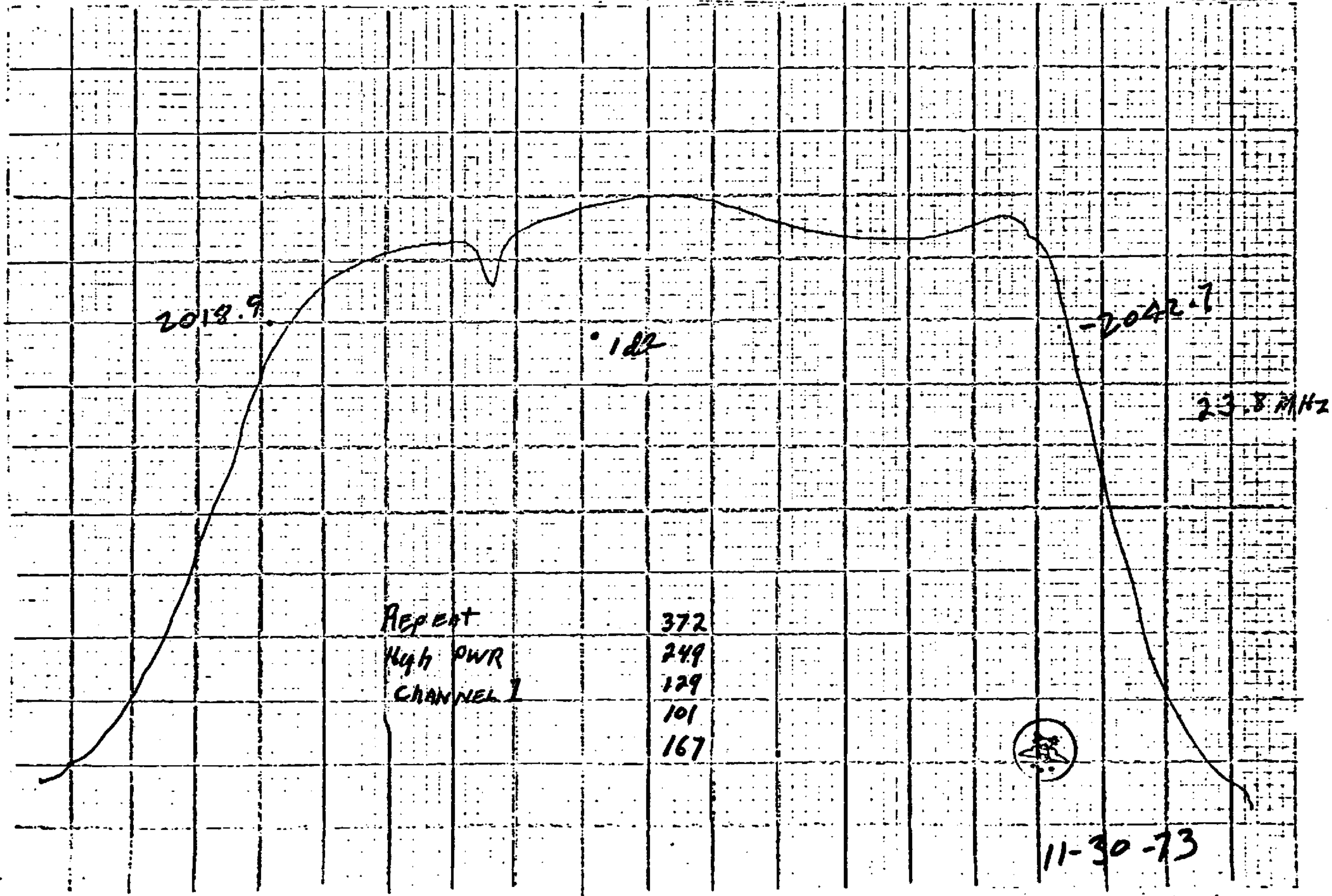


11-30-73

Filament voltage ______ V
Filament current ______ A
... current ______ A

Beam voltage __1__ kV
Beam current ______ A
Body current ______ mA

Power output __20__ kW
Drive power ______ mW
Gain ______ db



11-30 ●3

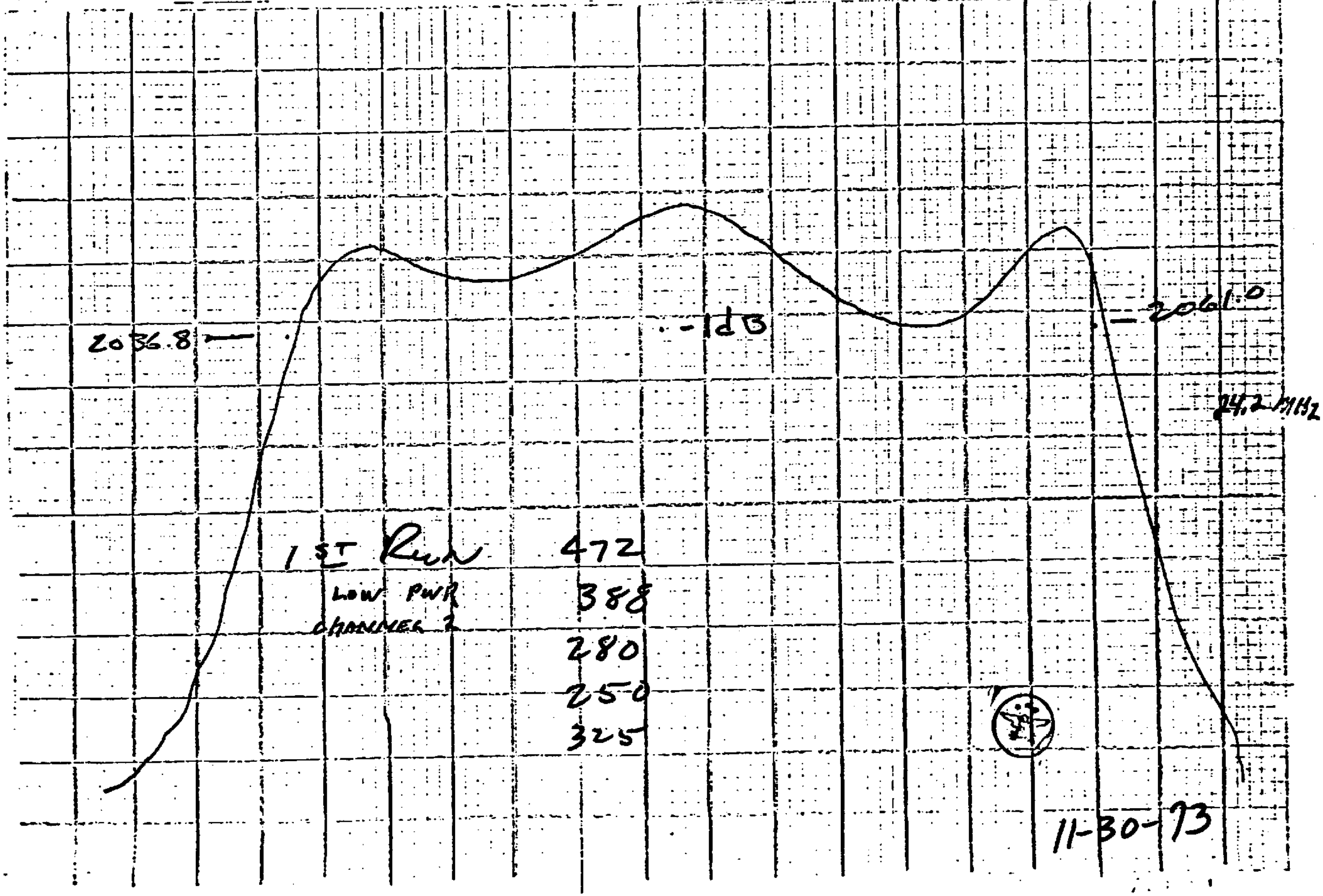
2048 MHz

2

Filament voltage ______ V
Filament current ______ A
... current ______ A

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 1 kW
Drive power ______ mW
Gain ______ db



2048

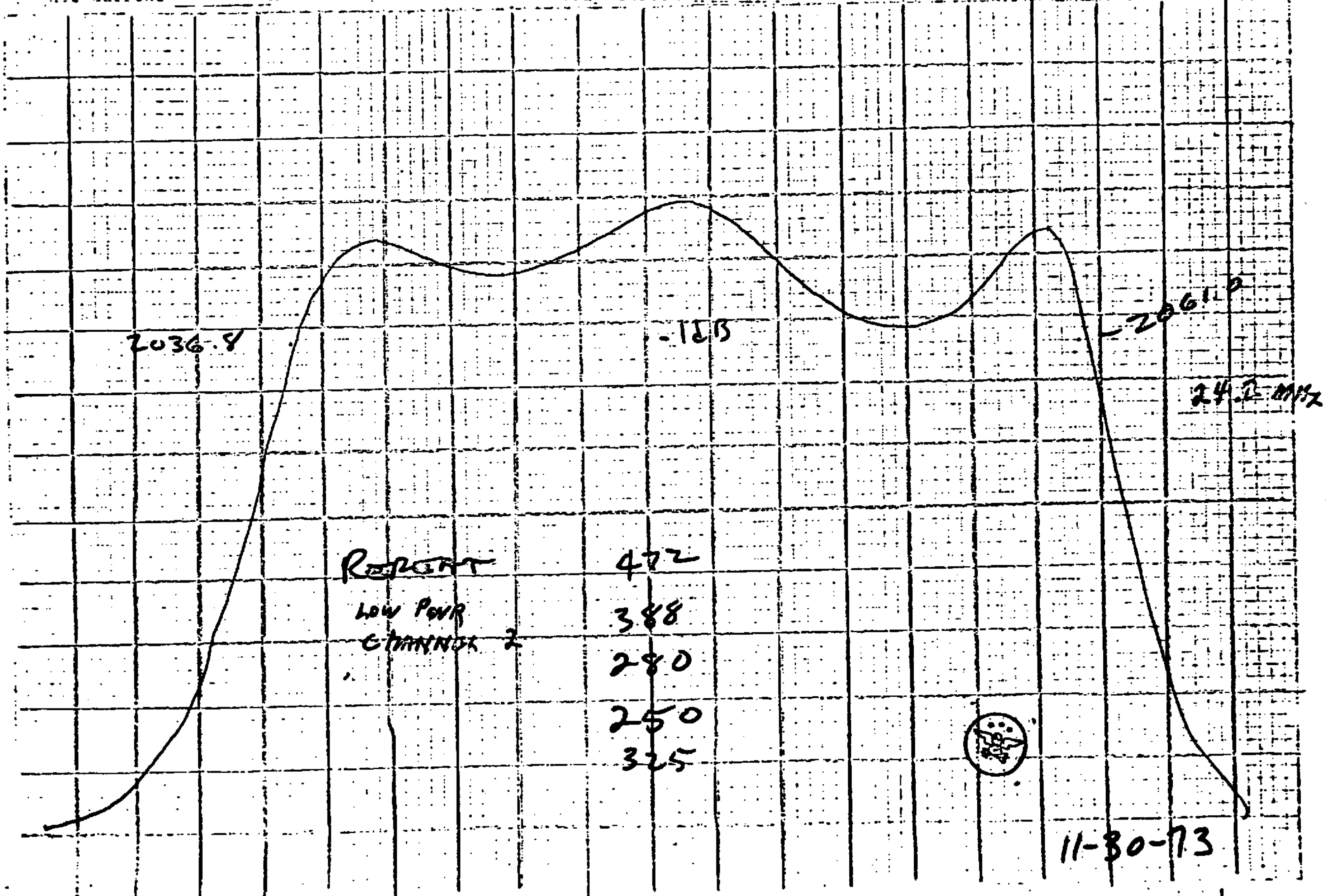
Filament voltage ________ V
Filament current ________ A
Magnet current ________ A

2

Beam voltage ________ kV
Beam current ________ A
Body current ________ mA

11-30-73

Power output 1 kW
Drive power ________ MW
Gain ________ db



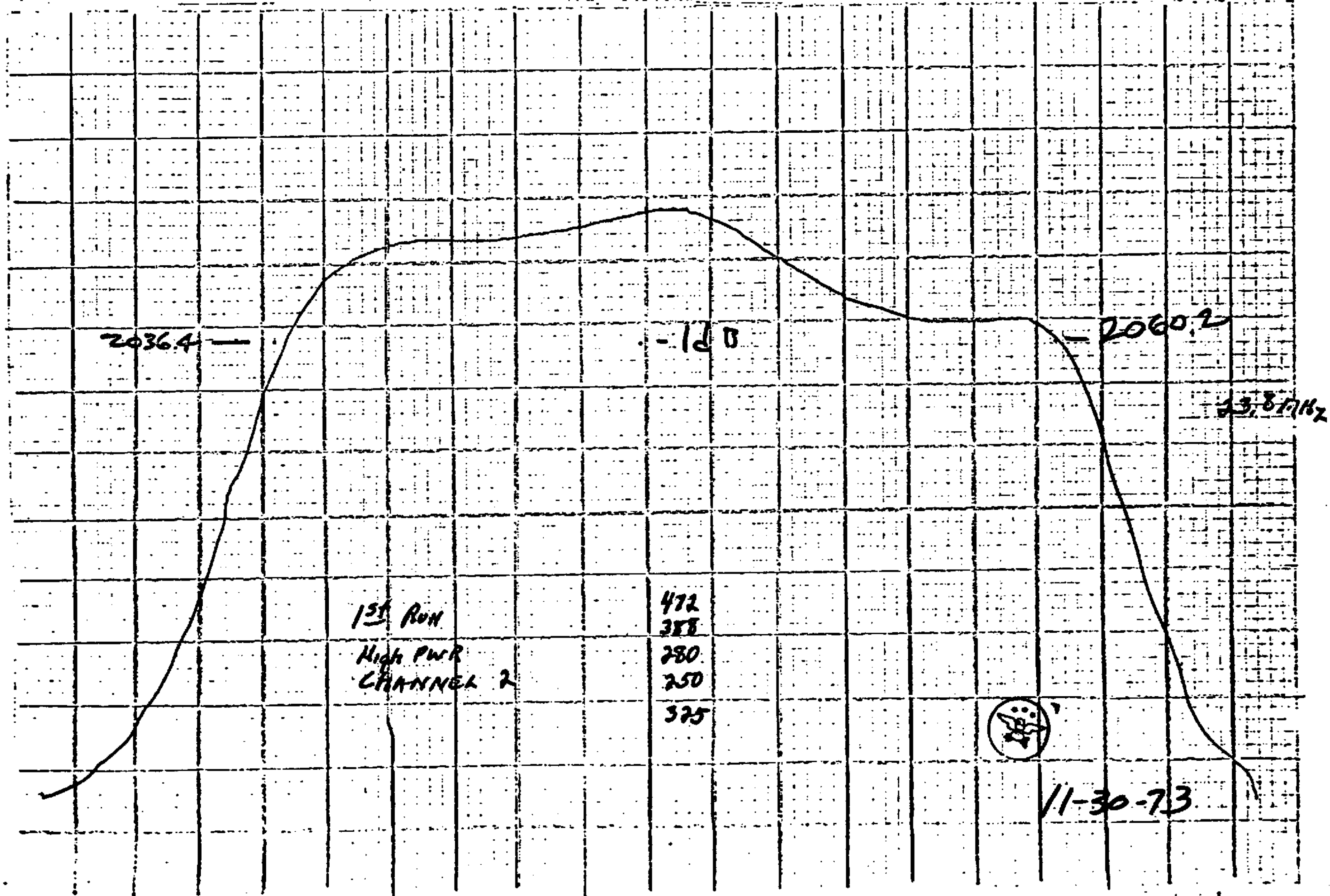
11-30-73

2

Mhz
Filament voltage ______ V
Filament current ______ A
... current ______ A

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 20 kW
Drive power ______ W
Gain ______ db



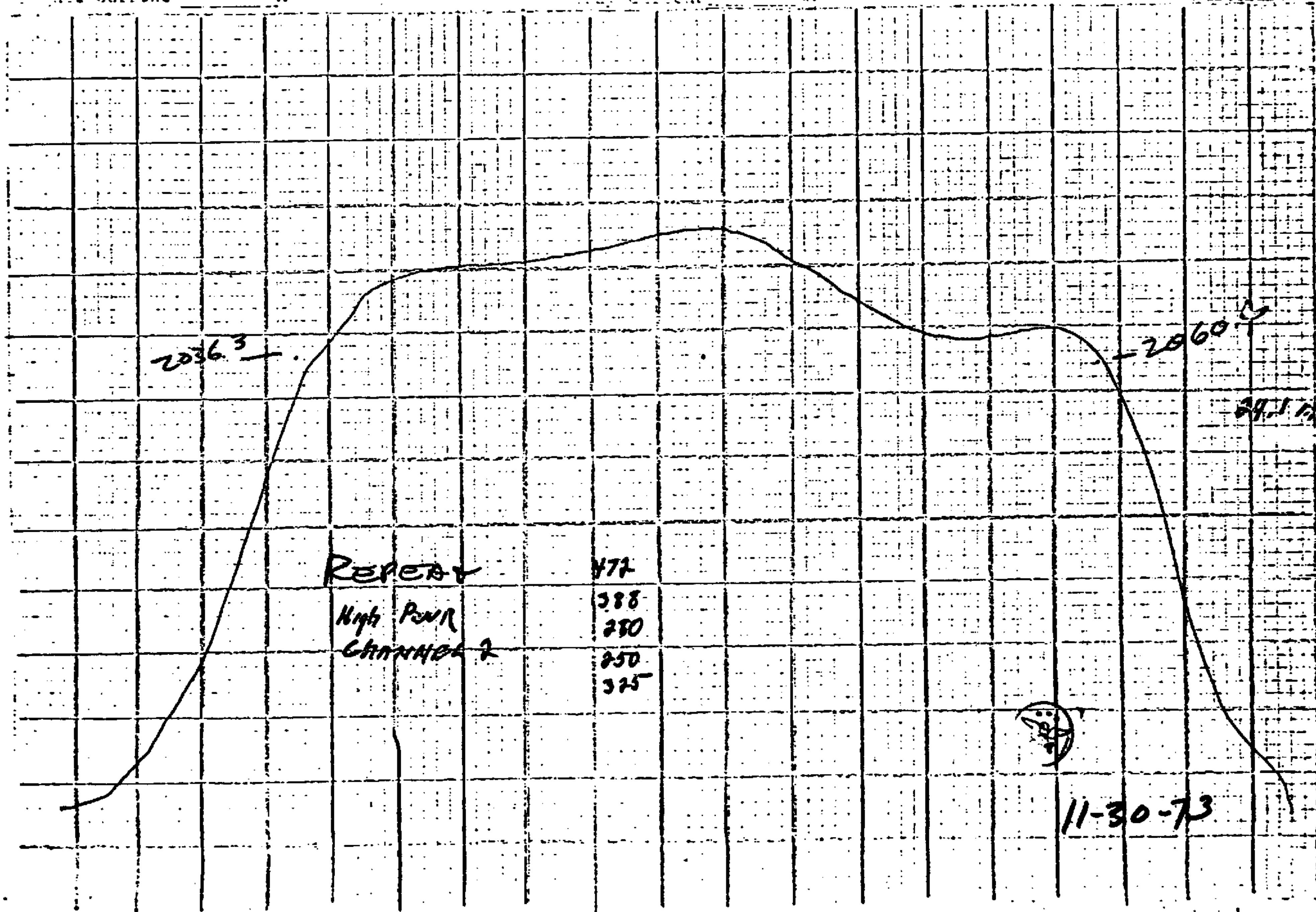
11-30-7.

2

Filament voltage ______ V
Filament current ______ A
Magnet current ______ A

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 20 kW
Drive power ______ mW
Gain ______ db



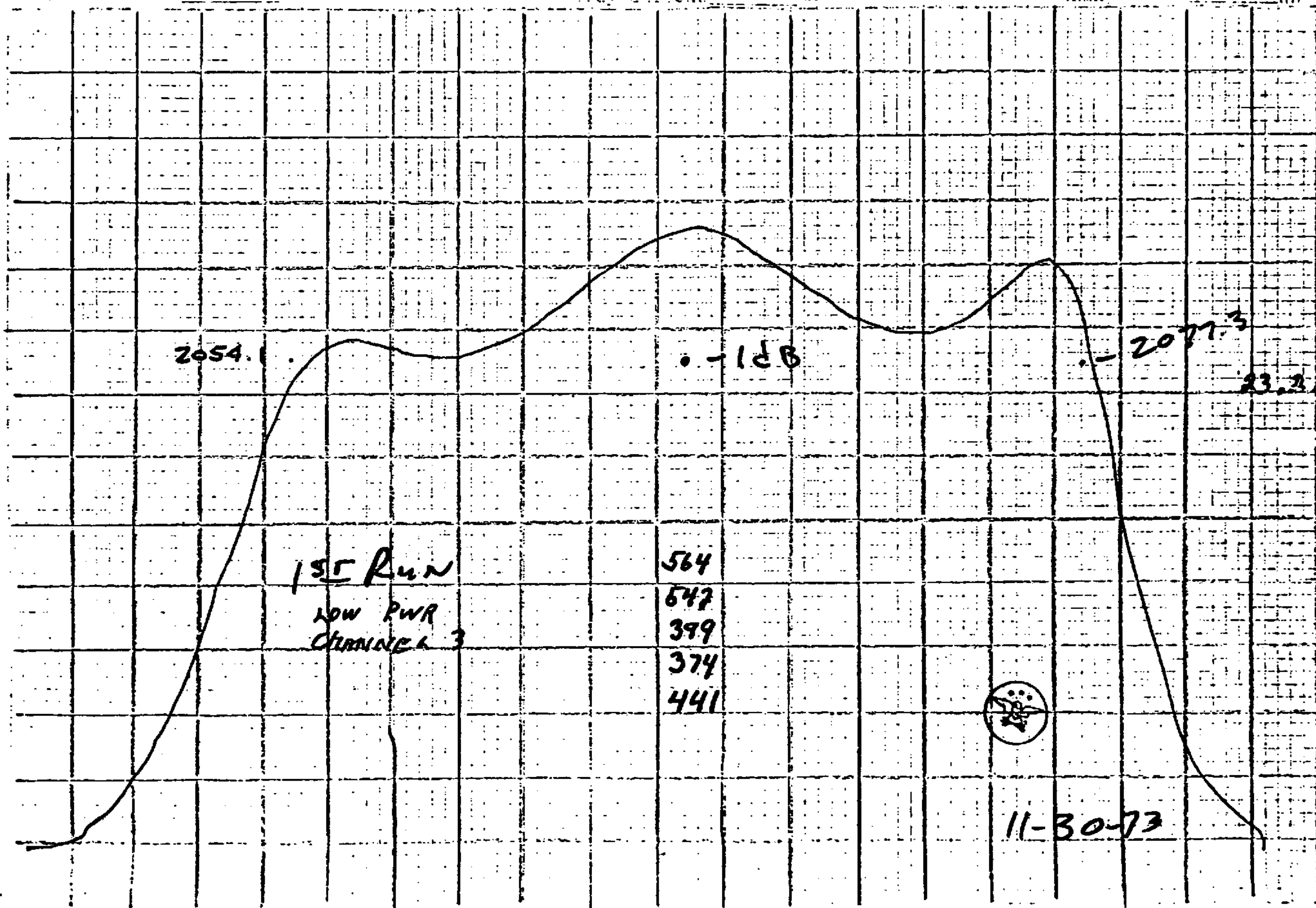
11-30-

3

Filament voltage ______ V
Filament current ______ A
... current ______ A

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 1 kW
Drive power ______ mW
Gain ______ db



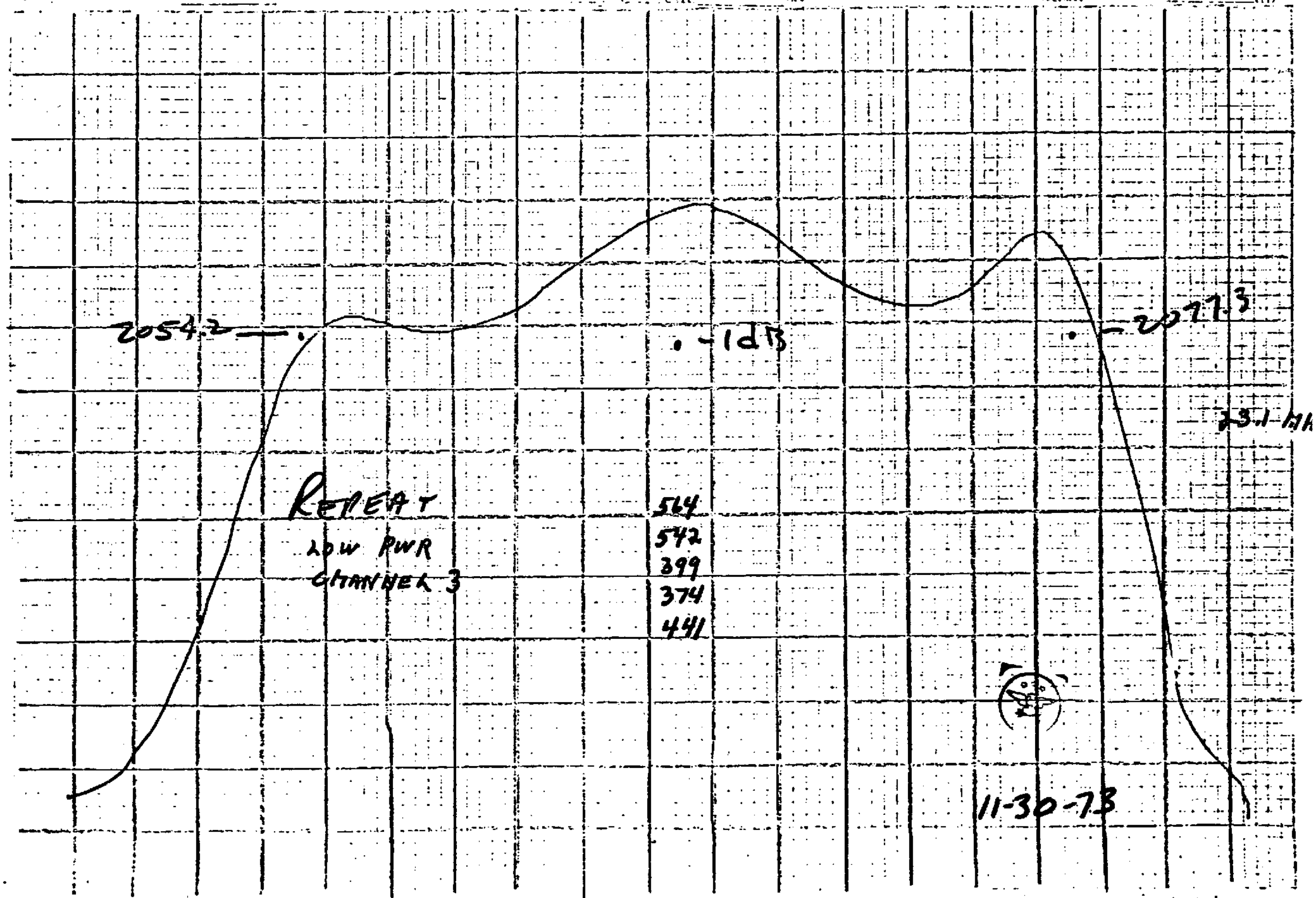
Date 11-30

Channel 3

Filament voltage ______ V
Filament current ______ A
Magnet current ______ A

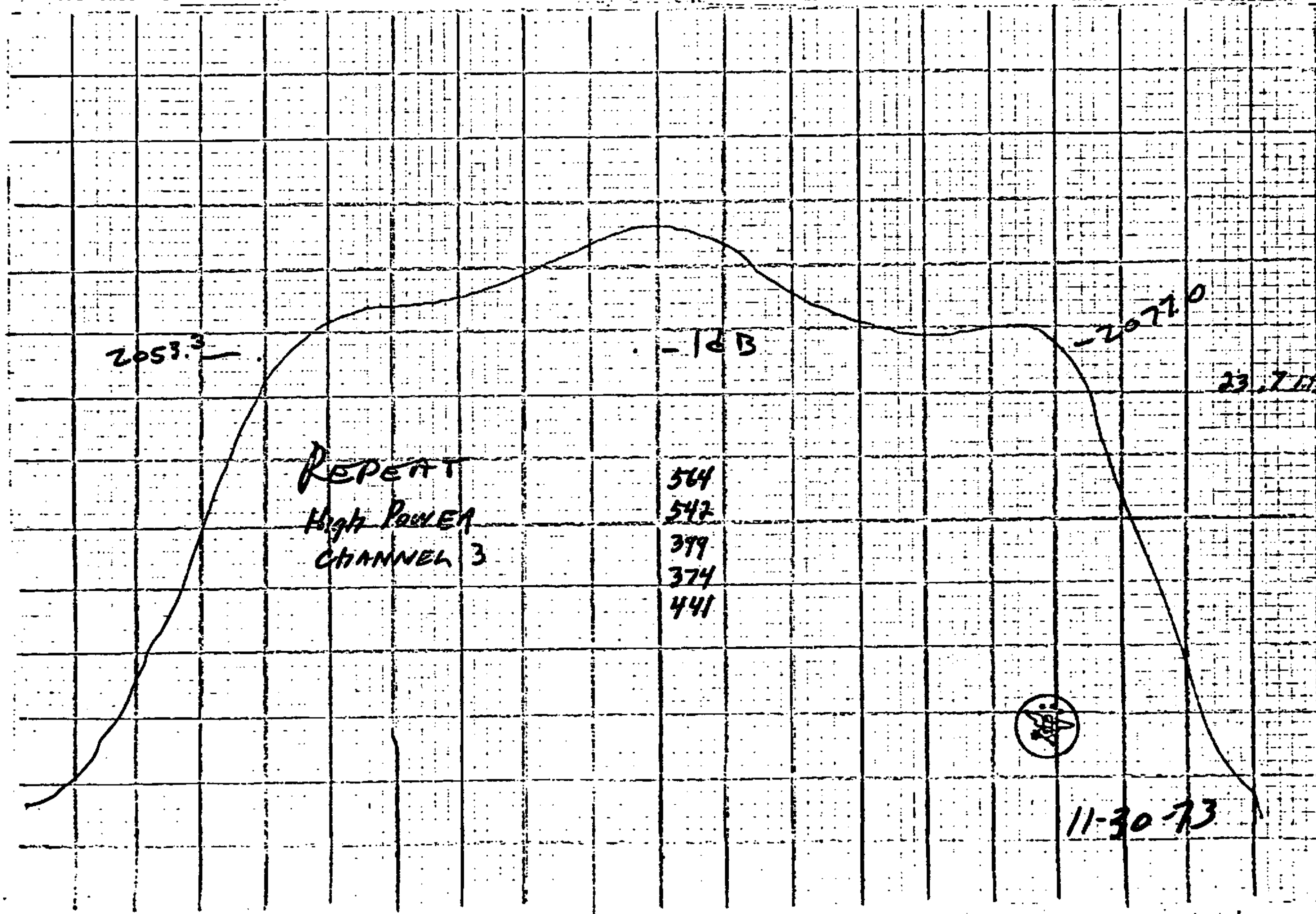
Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 1 kW
Drive power ______ mW
Gain ______ db



11-30 3

Filament voltage ______ V	Tube ___ 3	
Filament current ______ A	Beam voltage ______ kV	Power output 20 kW
Magnet current ______ A	Beam current ______ A	Drive power ______ MW
	Body current ______ mA	Gain ______ db



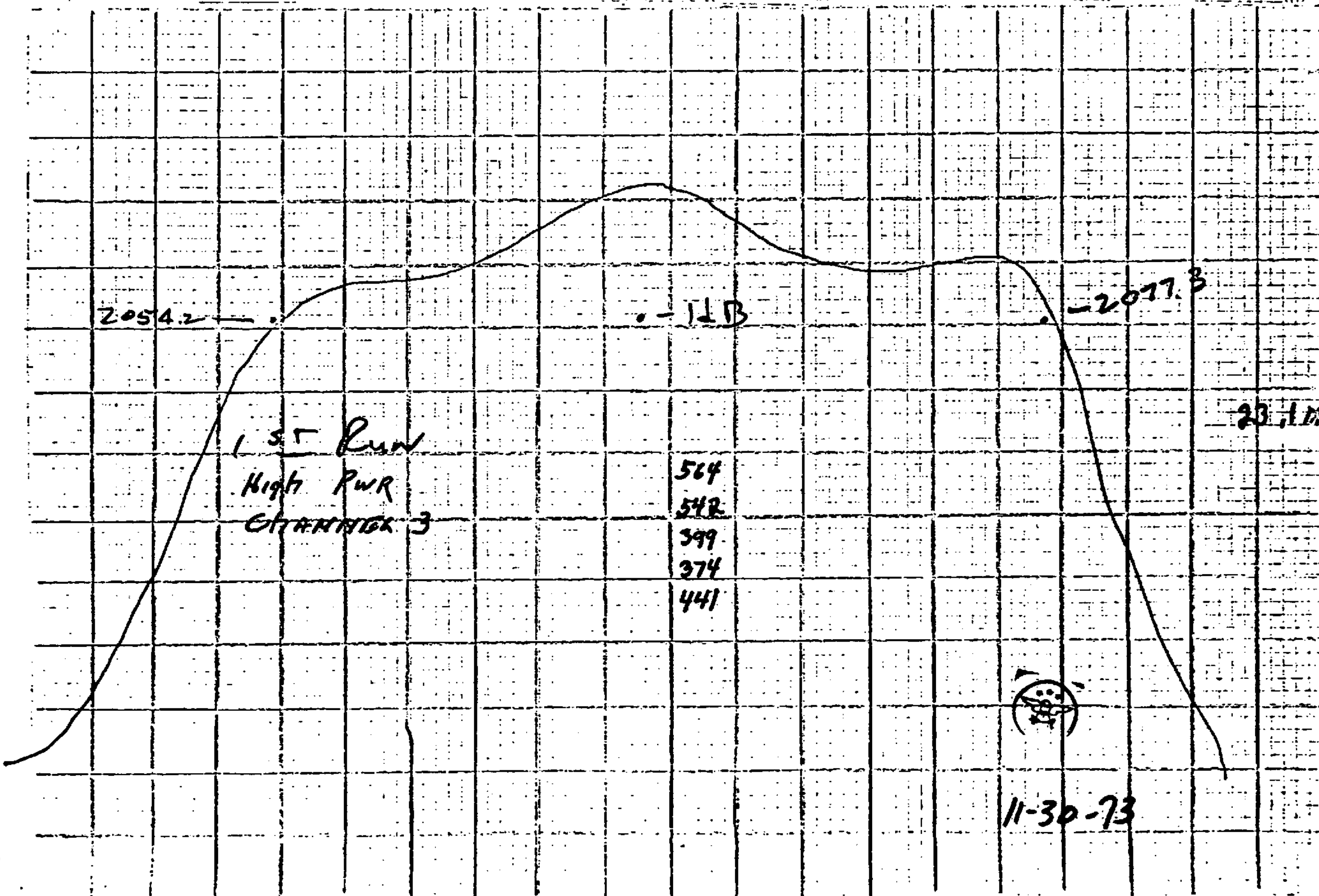
11-30

3

Filament voltage ______ V
Filament current ______ A
Magnet current ______ A

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 20 kW
Drive power ______ mW
Gain ______ db



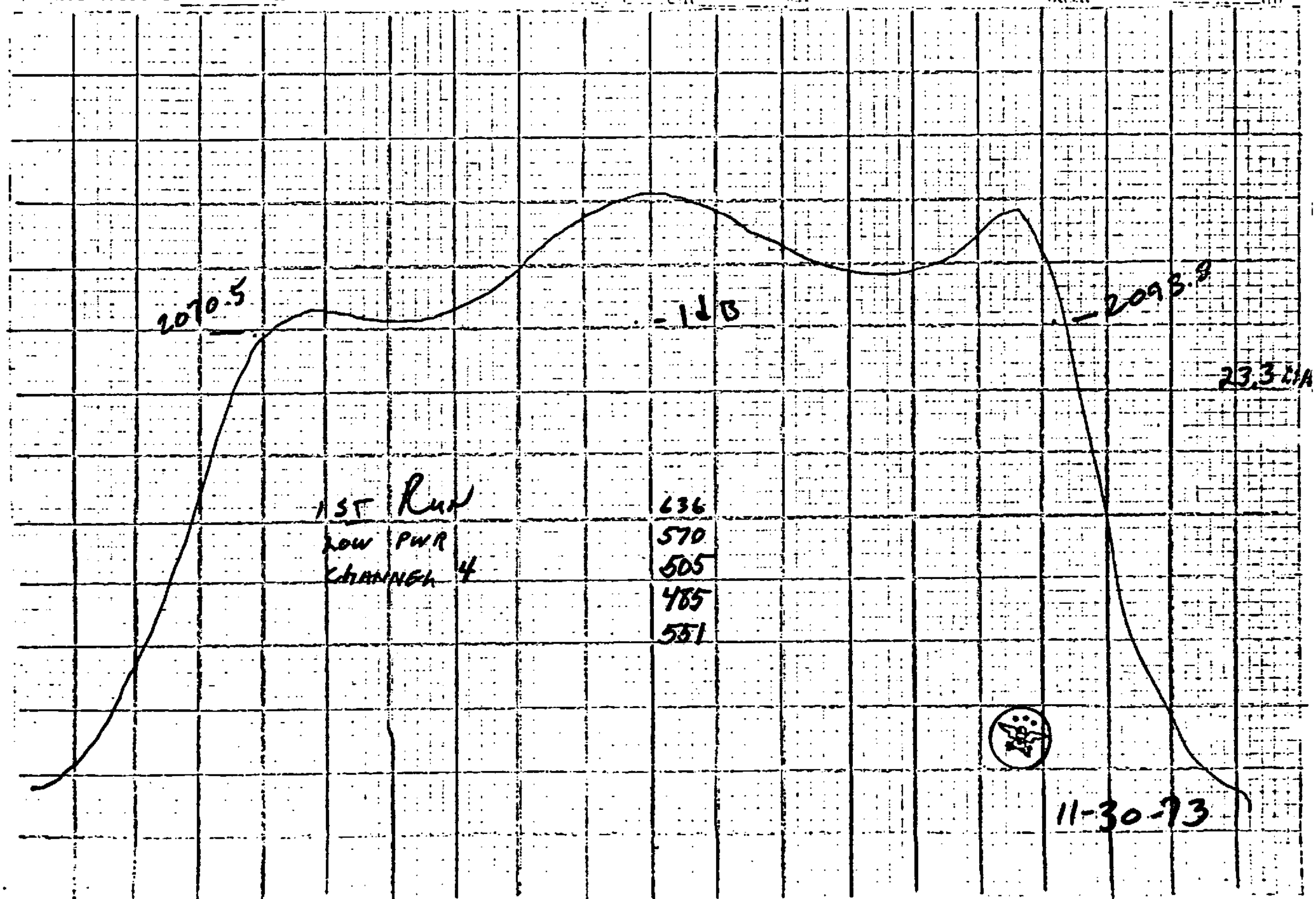
11-30

4

Filament voltage ______ V
Filament current ______ A
... current ______ A

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 1 kW
Drive power ______ mW
Gain ______ db

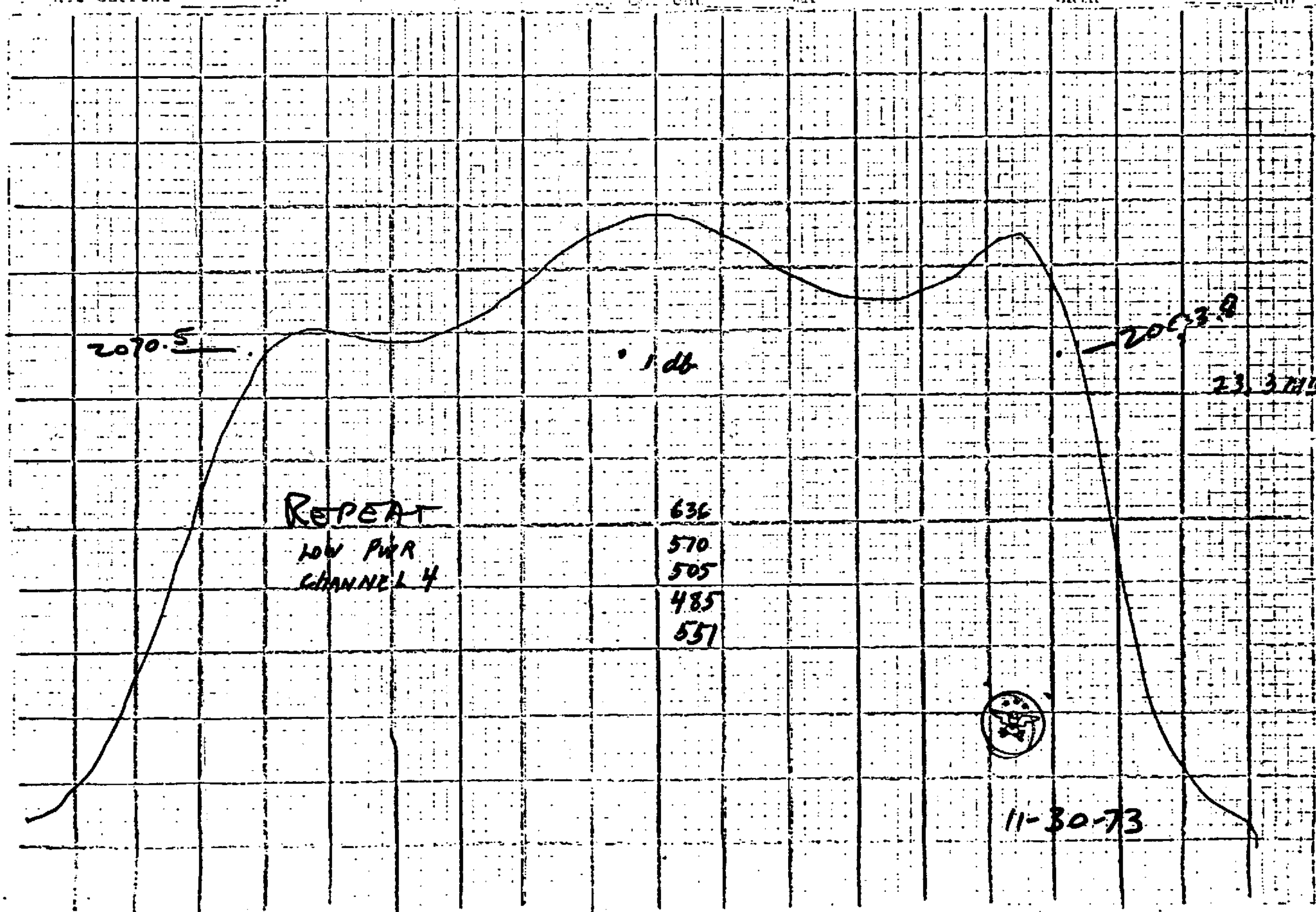


11-3 73

Filament voltage ______ V
Filament current ______ A
Magnet current ______ A

Beam voltage 4 kV
Beam current ______ A
Body current ______ mA

Power output 1 kW
Drive power ______ MW
Gain ______ db



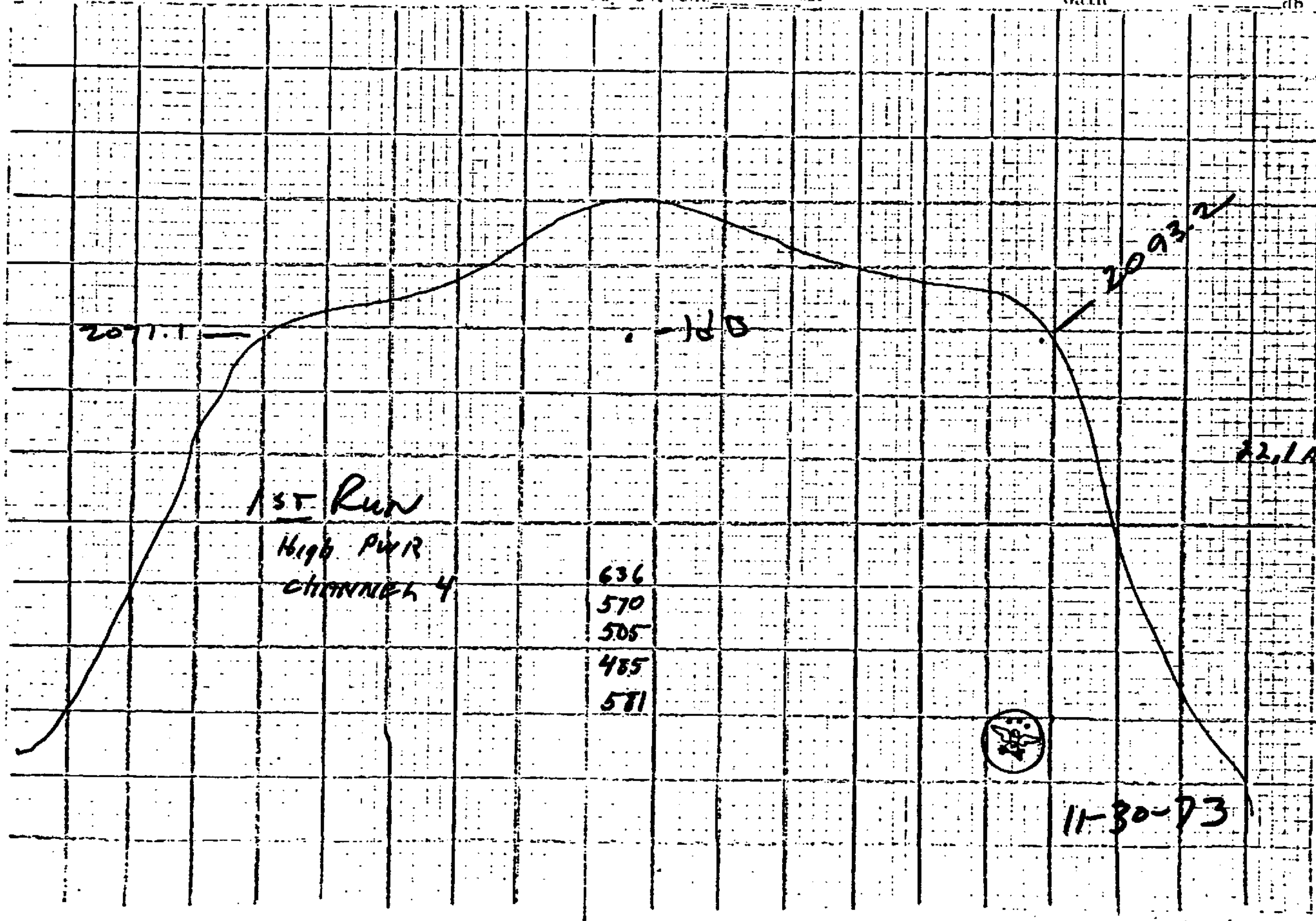
11-30-73

4

...ment voltage ______ V
...ament current ______ A
...net current ______ A

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 20 kW
Drive power ______ W
Gain ______ db



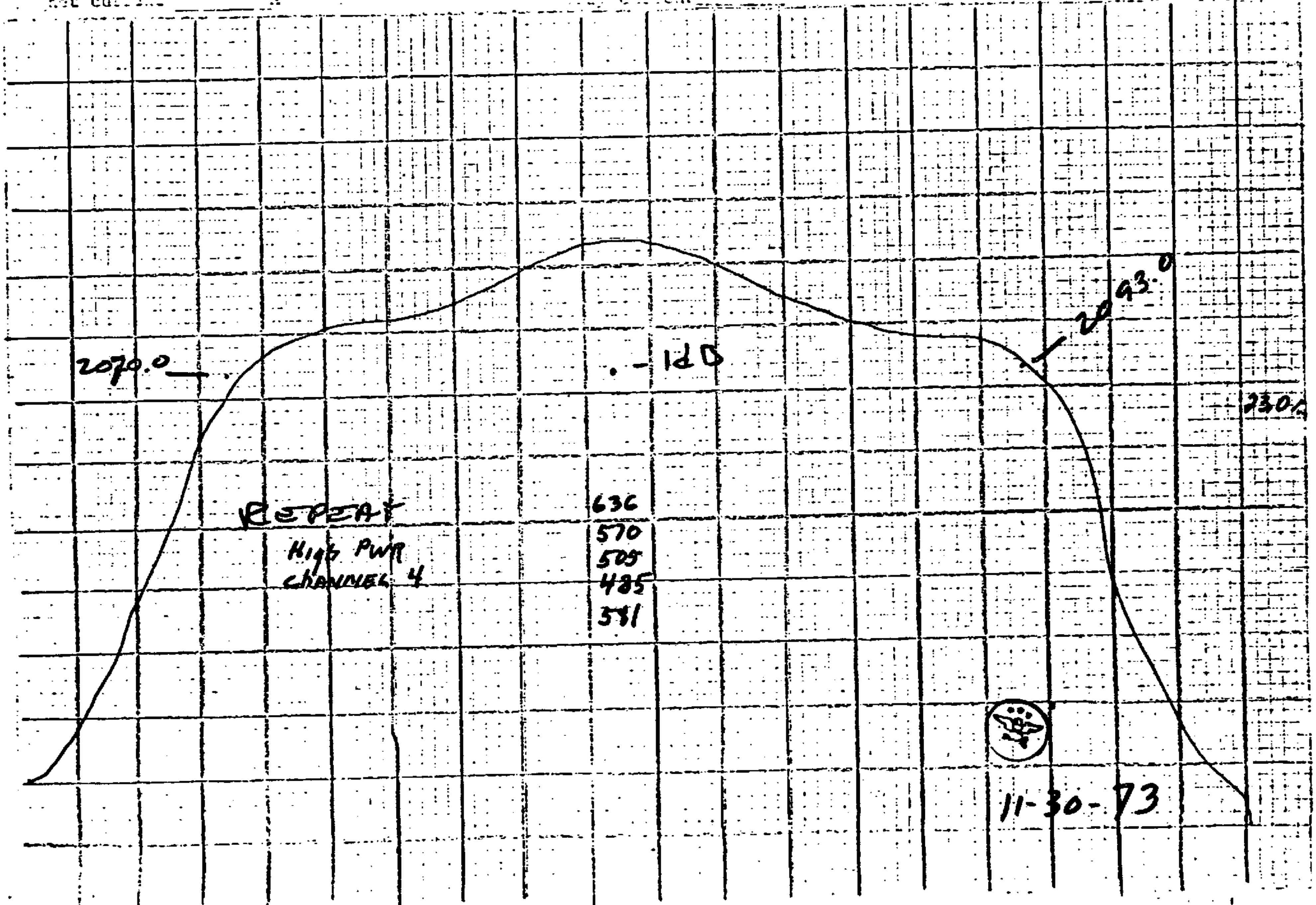
11-3 73

Filament voltage ______ V
Filament current ______ A
Magnet current ______ A

4

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

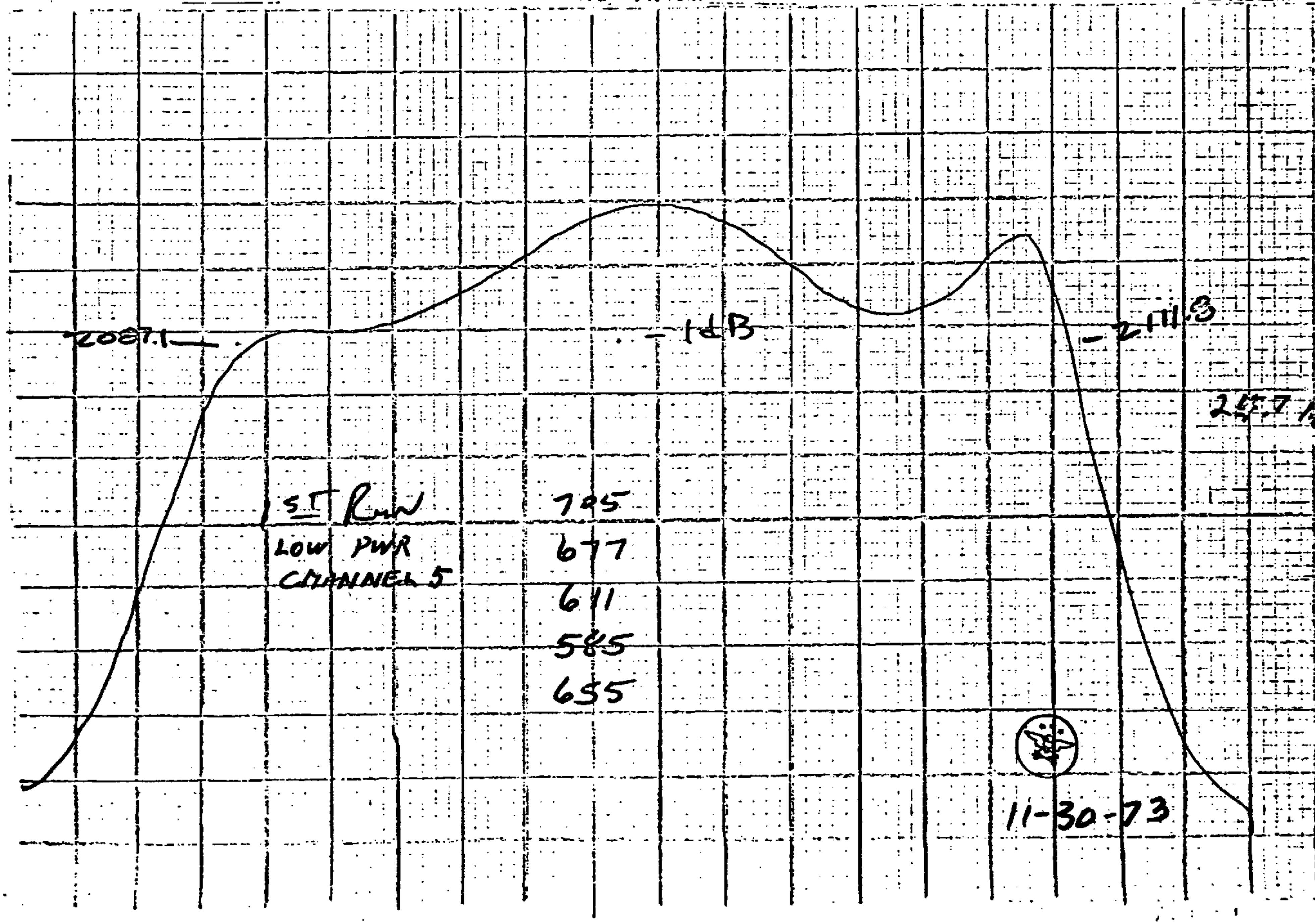
Power output 20 kW
Drive power ______ MW
Gain ______ db



11-3L

5

...ment voltage ______ V | Beam voltage ______ kV | Power output 1 kW
...ament current ______ A | Beam current ______ A | Drive power ______ W
...ent current ______ A | Body current ______ mA | Gain ______ db



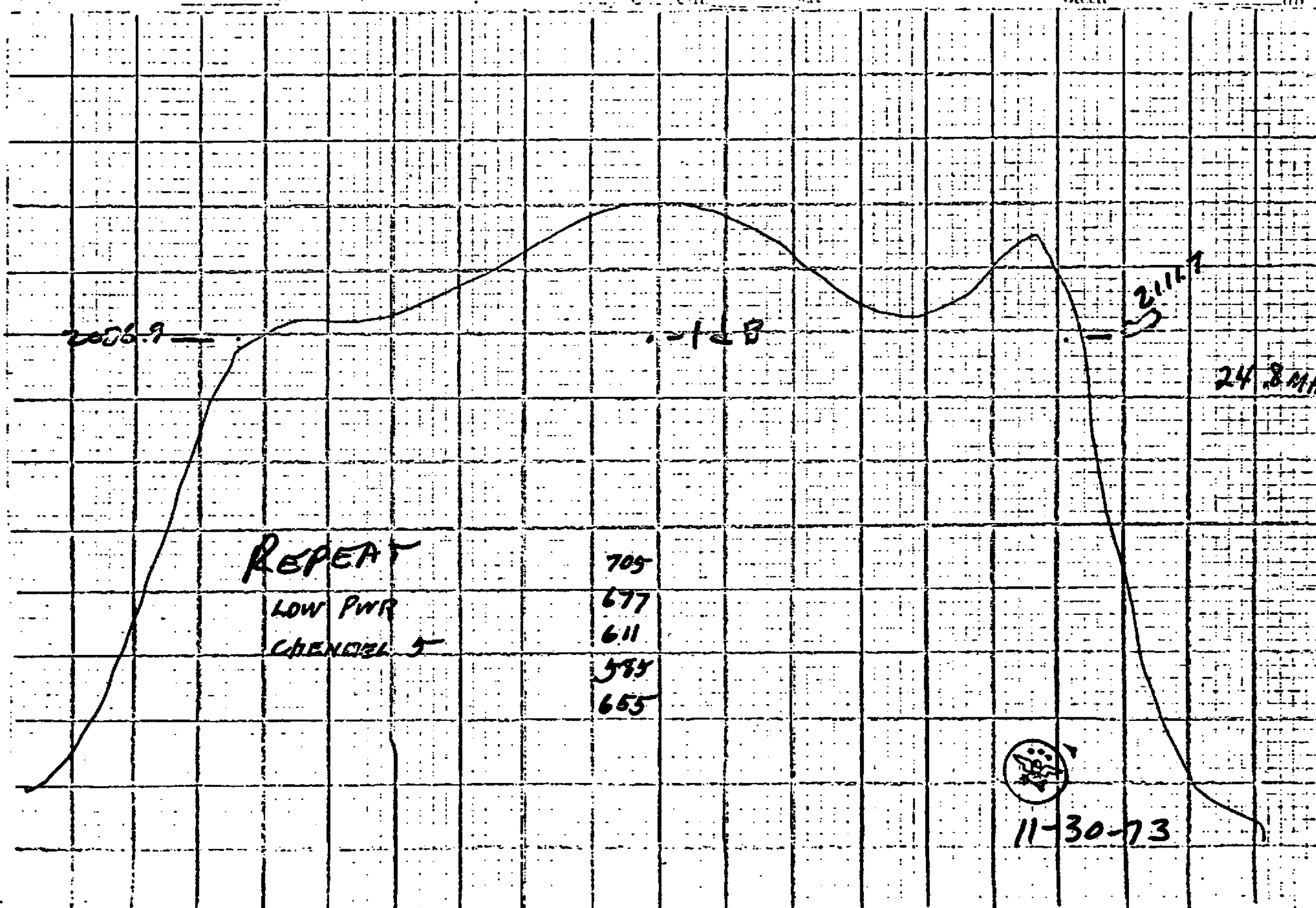
11-30-

5

Filament voltage ______ V
Filament current ______ A
[illegible] current ______ A

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 1 kW
Drive power ______ mW
Gain ______ db



Date 11-30-73

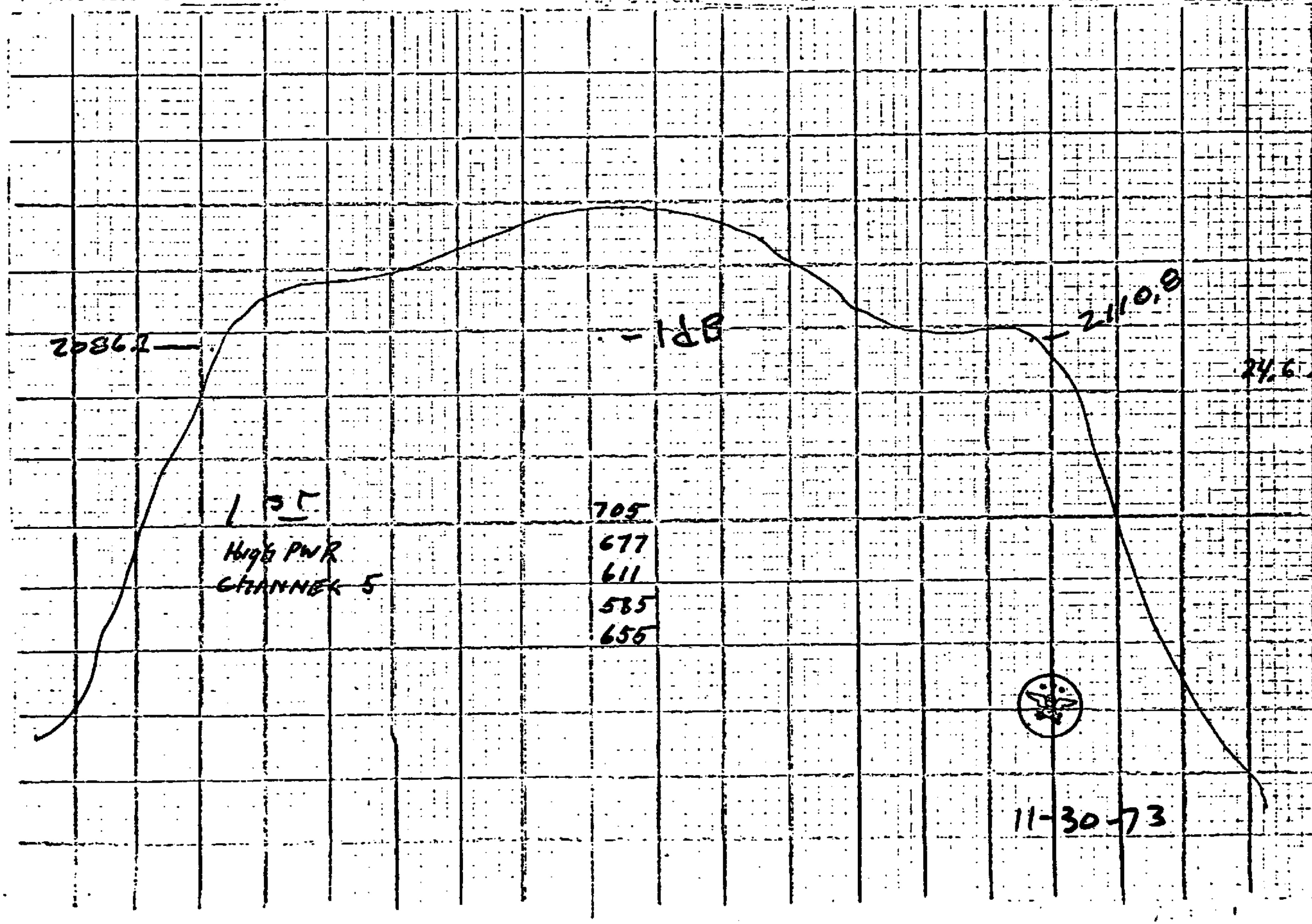
Tube # 5

___ Mhz

Filament voltage ___ V
Filament current ___ A
___ current ___ A

Beam voltage ___ kV
Beam current ___ A
Body current ___ mA

Power output 20 kW
Drive power ___ MW
Gain ___ db



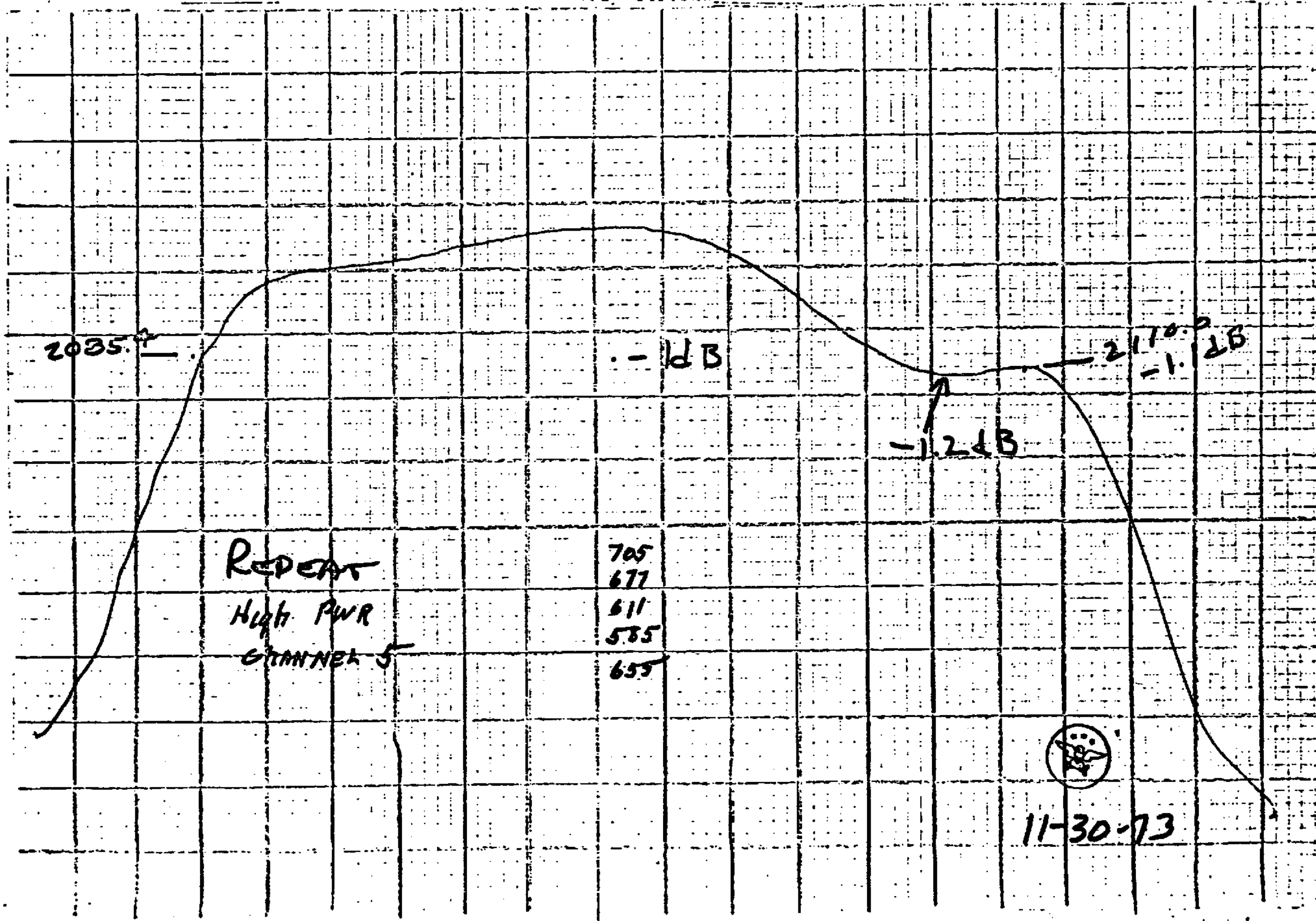
11-30-73

Tube No. 5

Filament voltage ______ V
Filament current ______ A
Magnet current ______ A

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 20 kW
Drive power ______ MW
Gain ______ db



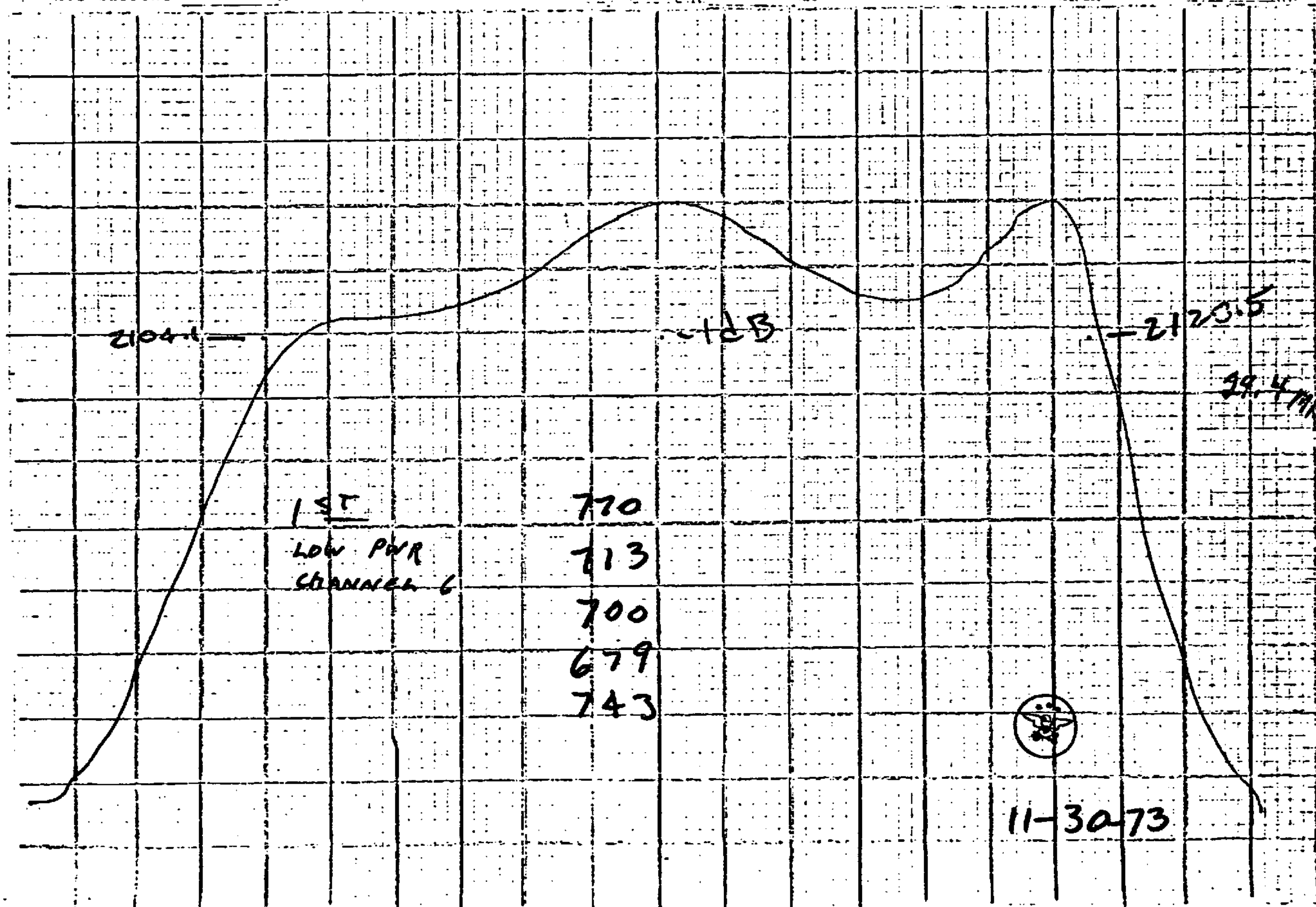
11-30 3

6

Filament voltage ________ V
Filament current ________ A
Magnet current ________ A

Beam voltage ________ kV
Beam current ________ A
Body current ________ mA

Power output 1 kW
Drive power ________ mW
Gain ________ db



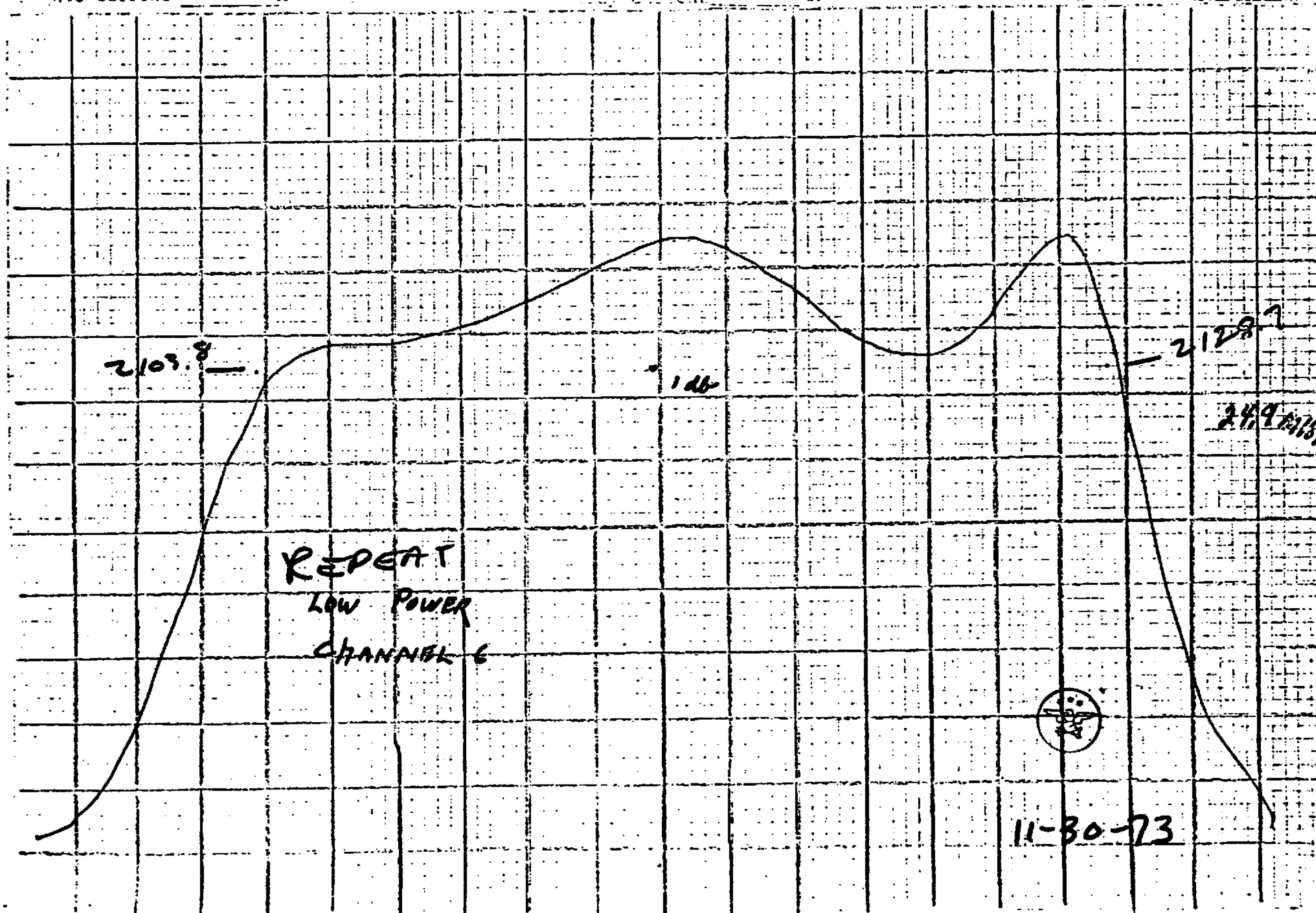
11 30

Tube 6

Filament voltage ___ V
Filament current ___ A
... current ___ A

Beam voltage ___ kV
Beam current ___ A
Body current ___ mA

Power output 1 kW
Drive power ___ MW
Gain ___ db



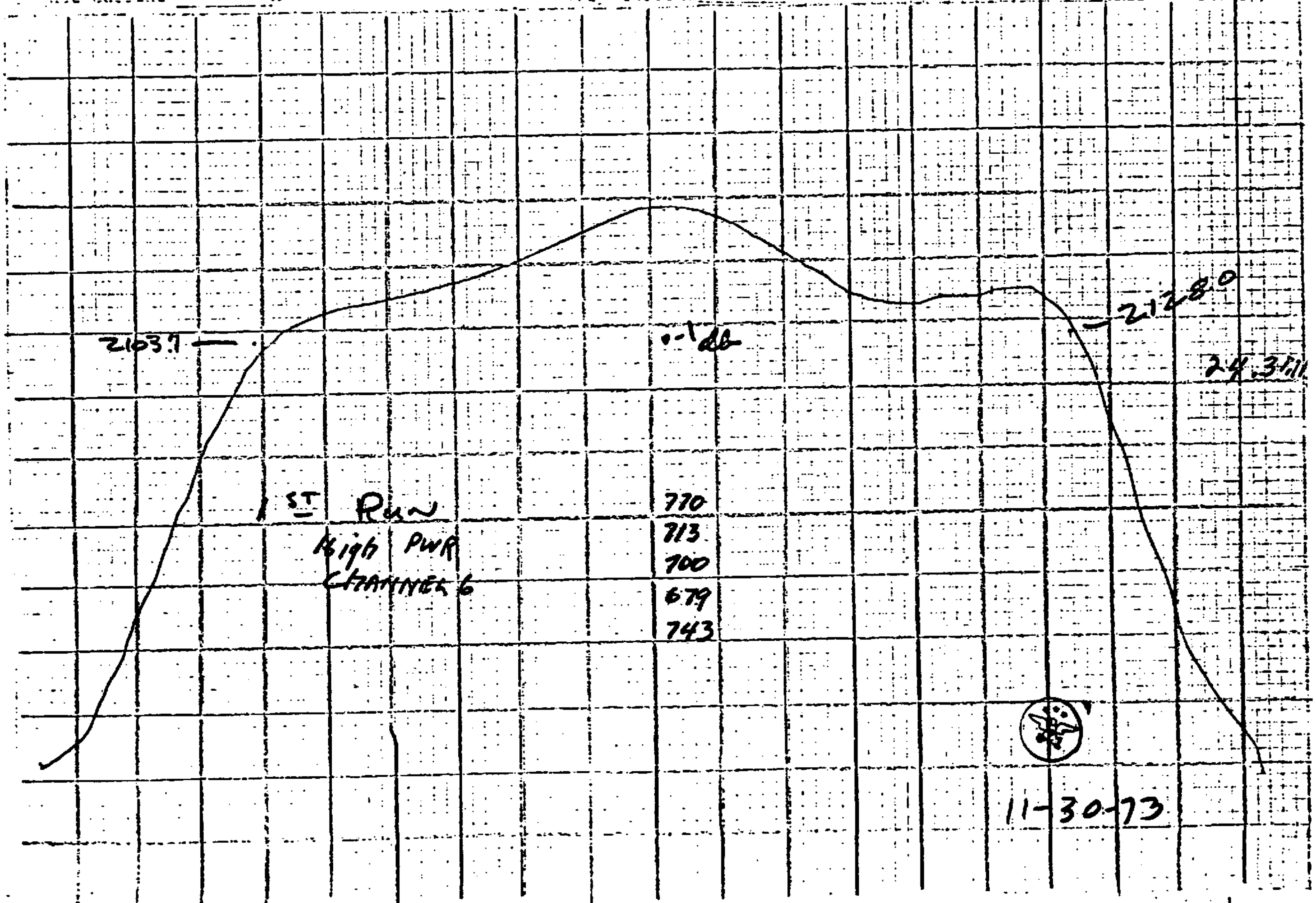
11-30-73

Filament voltage ________ V
Filament current ________ A
Heat current ________ A

Channel 6

Beam voltage ________ kV
Beam current ________ A
Body current ________ mA

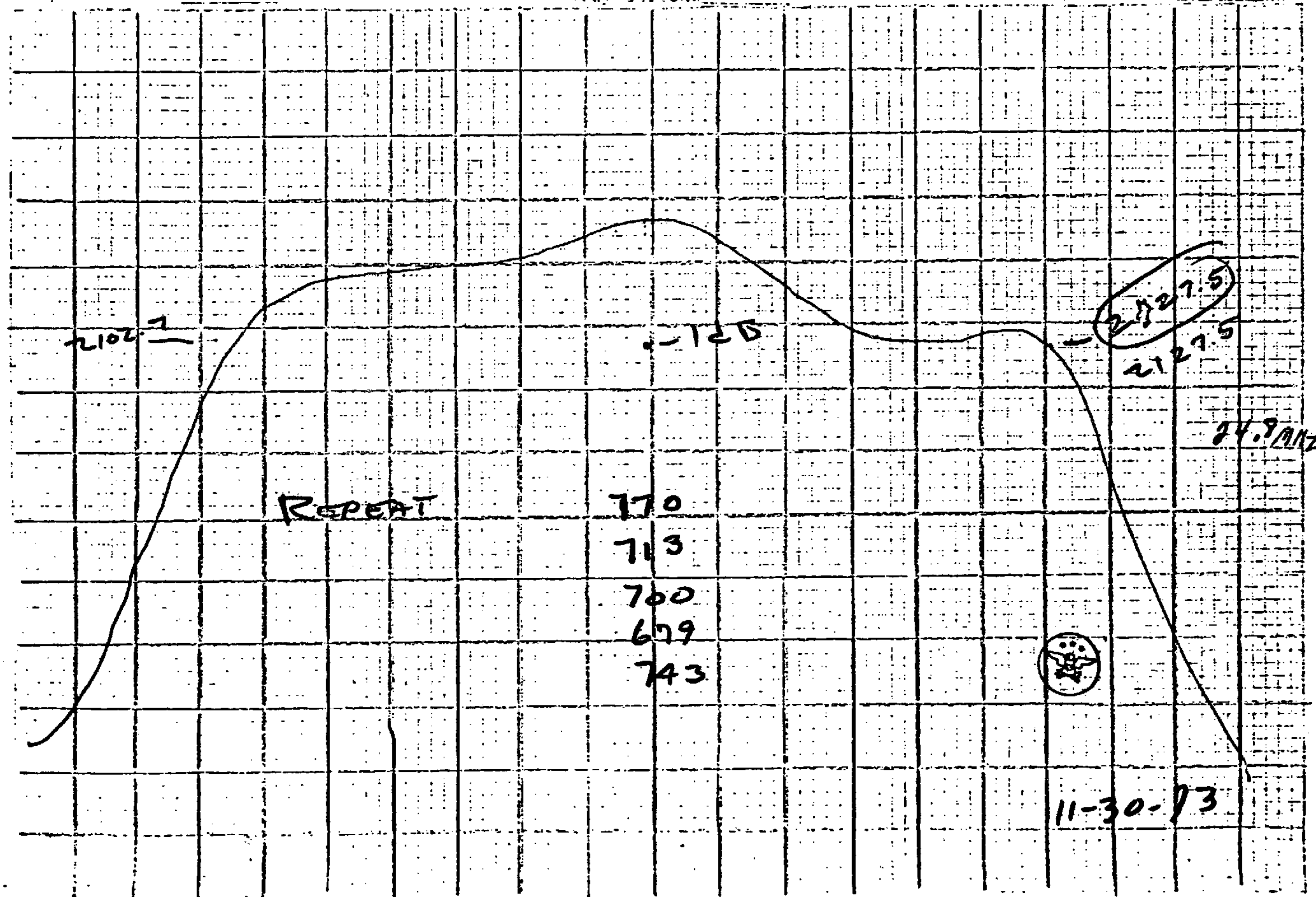
Power output 20 kW
Drive power ________ mW
Gain ________ db



Date 11-3●73

Tube No. 6

______ Vac		
Filament voltage ______ V	Beam voltage ______ kV	Power output 20 kW
Filament current ______ A	Beam current ______ A	Drive power ______ W
Magnet current ______ A	Body current ______ mA	Gain ______ db

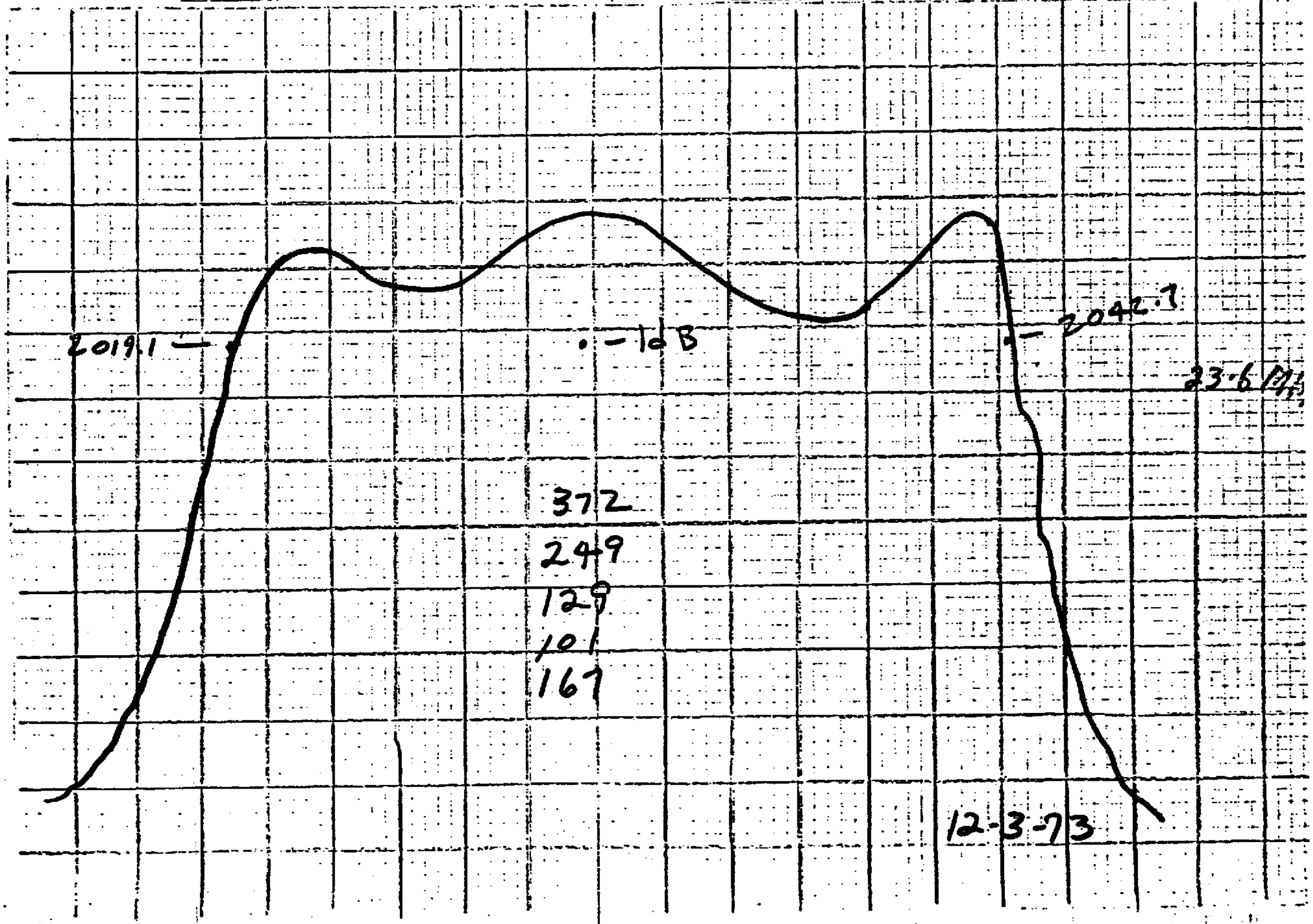


12-3-73

Filament voltage ______ V
Filament current ______ A
[illegible] current ______ A

Beam voltage __1__ kV
Beam current ______ A
Body current ______ mA

Power output __2__ kW
Drive power ______ W
Gain ______ dB

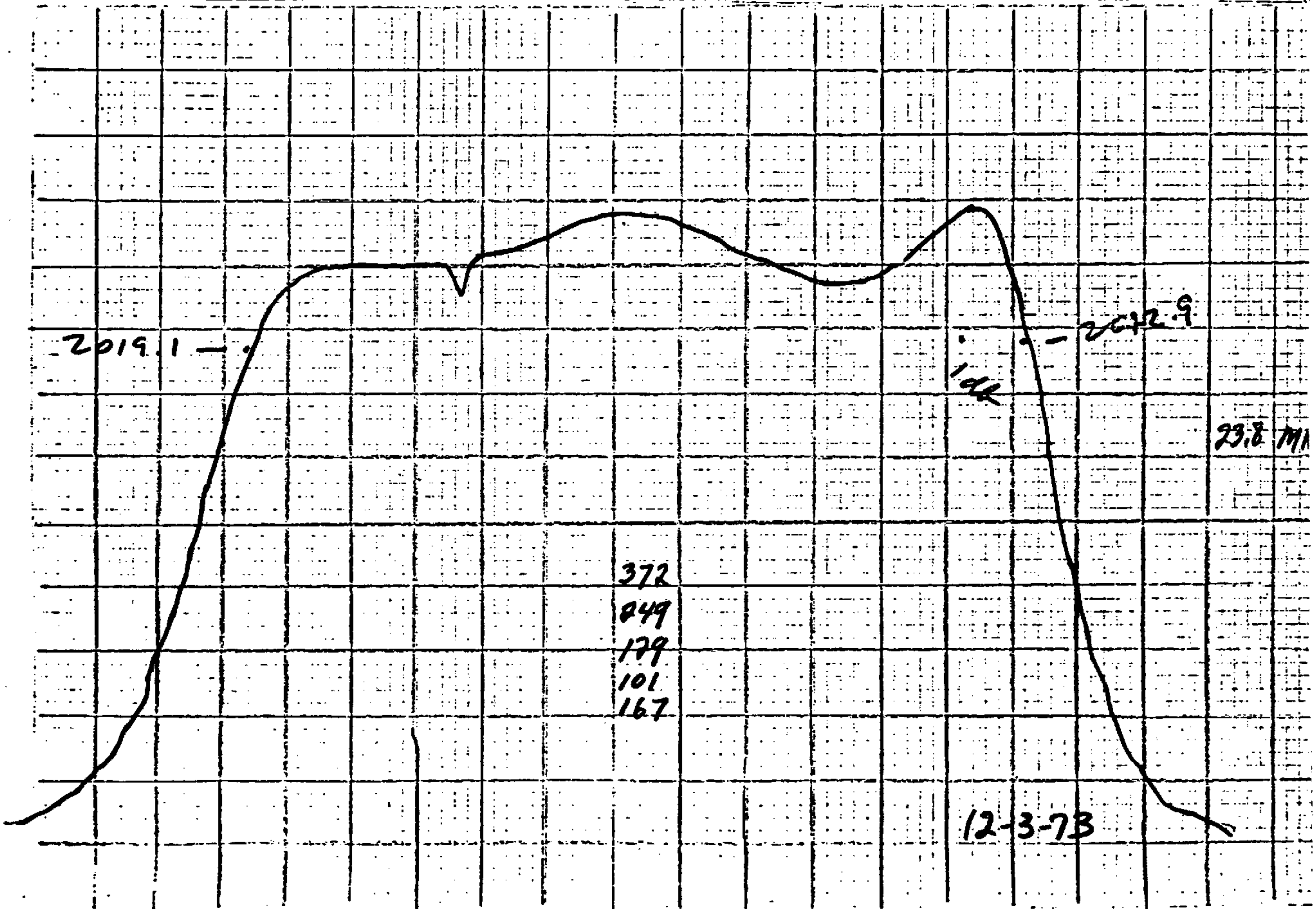


3-73

Filament voltage ______ V
Filament current ______ A
...ent current ______ A

Beam voltage __1__ kV
Beam current ______ A
Body current ______ mA

Power output __10__
Drive power ______
Gain ______



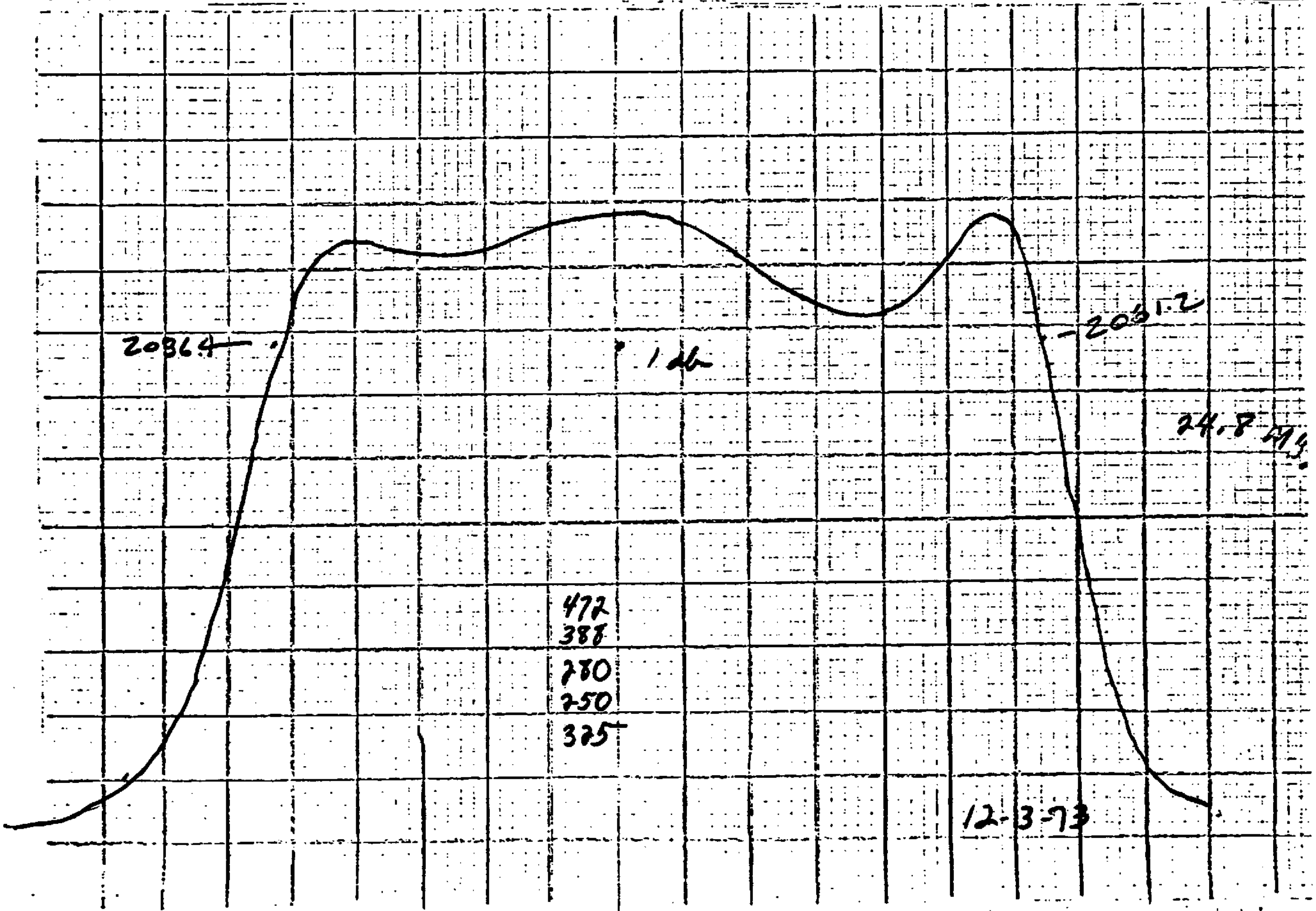
12 -73

Filament voltage ______ V
Filament current ______ A
... current ______ A

8

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 2
Drive power ______
Gain ______

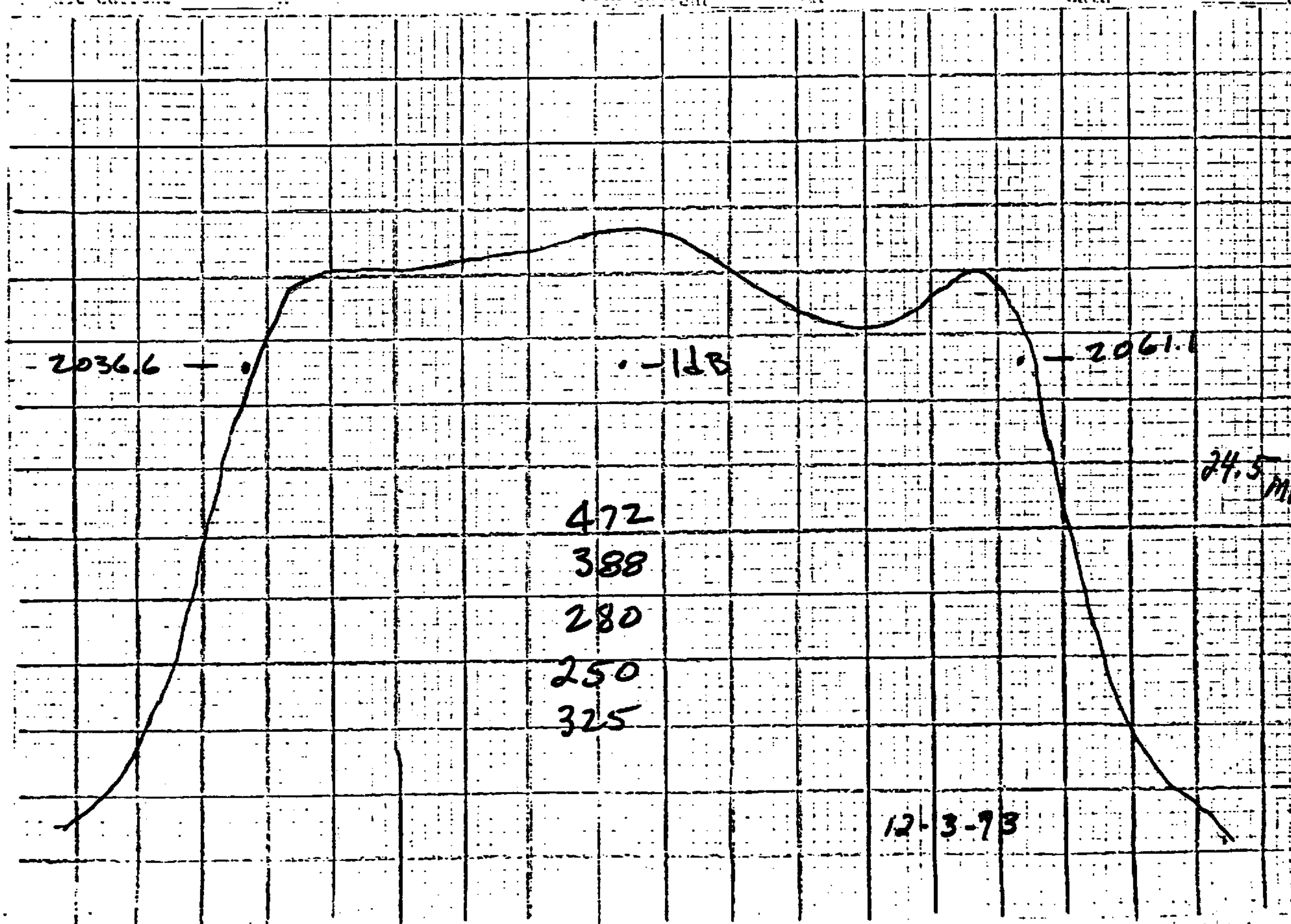


12-●-73

Filament voltage ______ V
Filament current ______ A
Anode current ______ A

Beam voltage __2__ kV
Beam current ______ A
Body current ______ mA

Power output __10__
Drive power ______
Gain ______ d

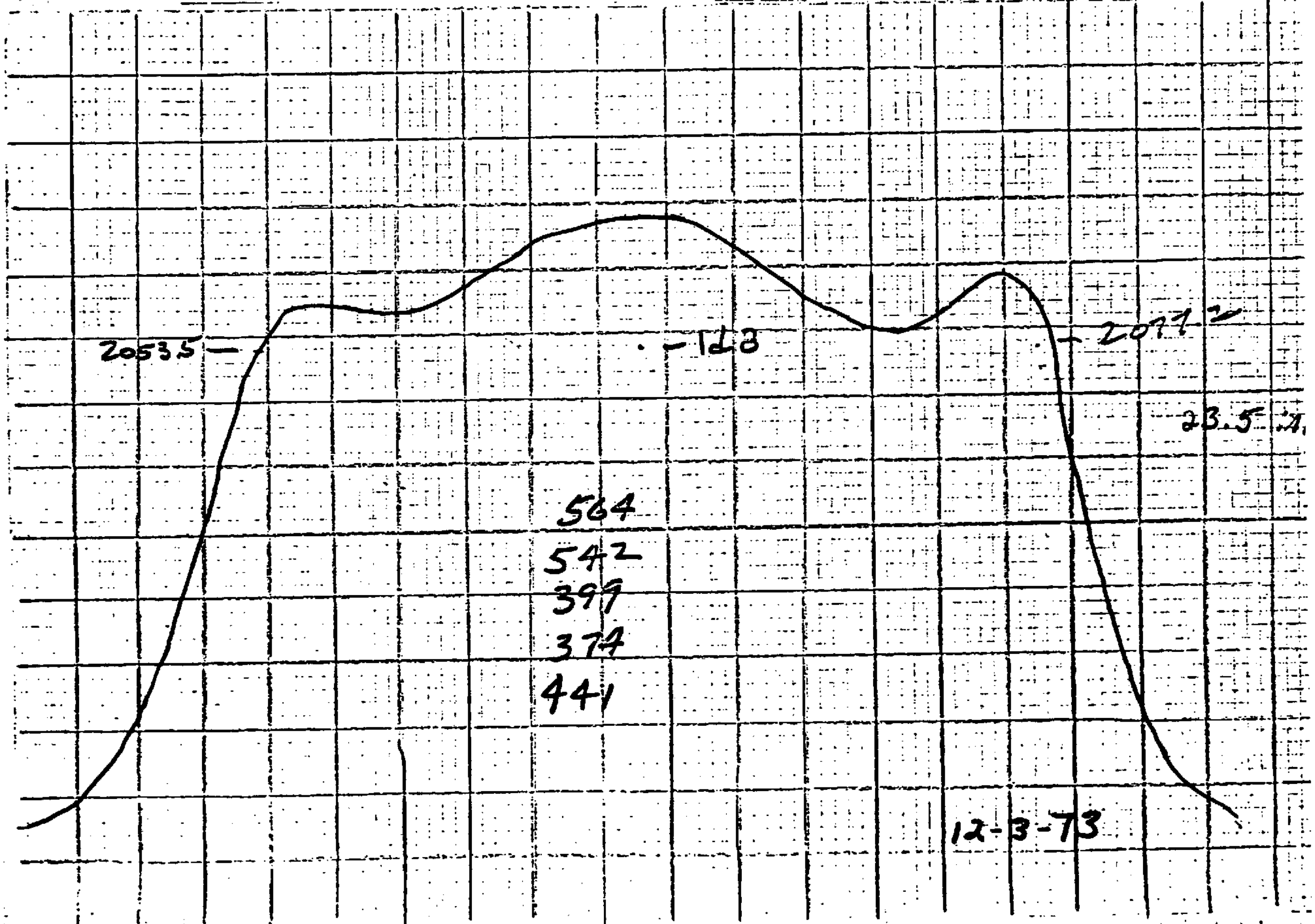


12-3-73

Filament voltage ______ V
Filament current ______ A
Magnet current ______ A

Beam voltage 3 kV
Beam current ______ A
Body current ______ mA

Power output 2 k
Drive power ______
Gain ______ d

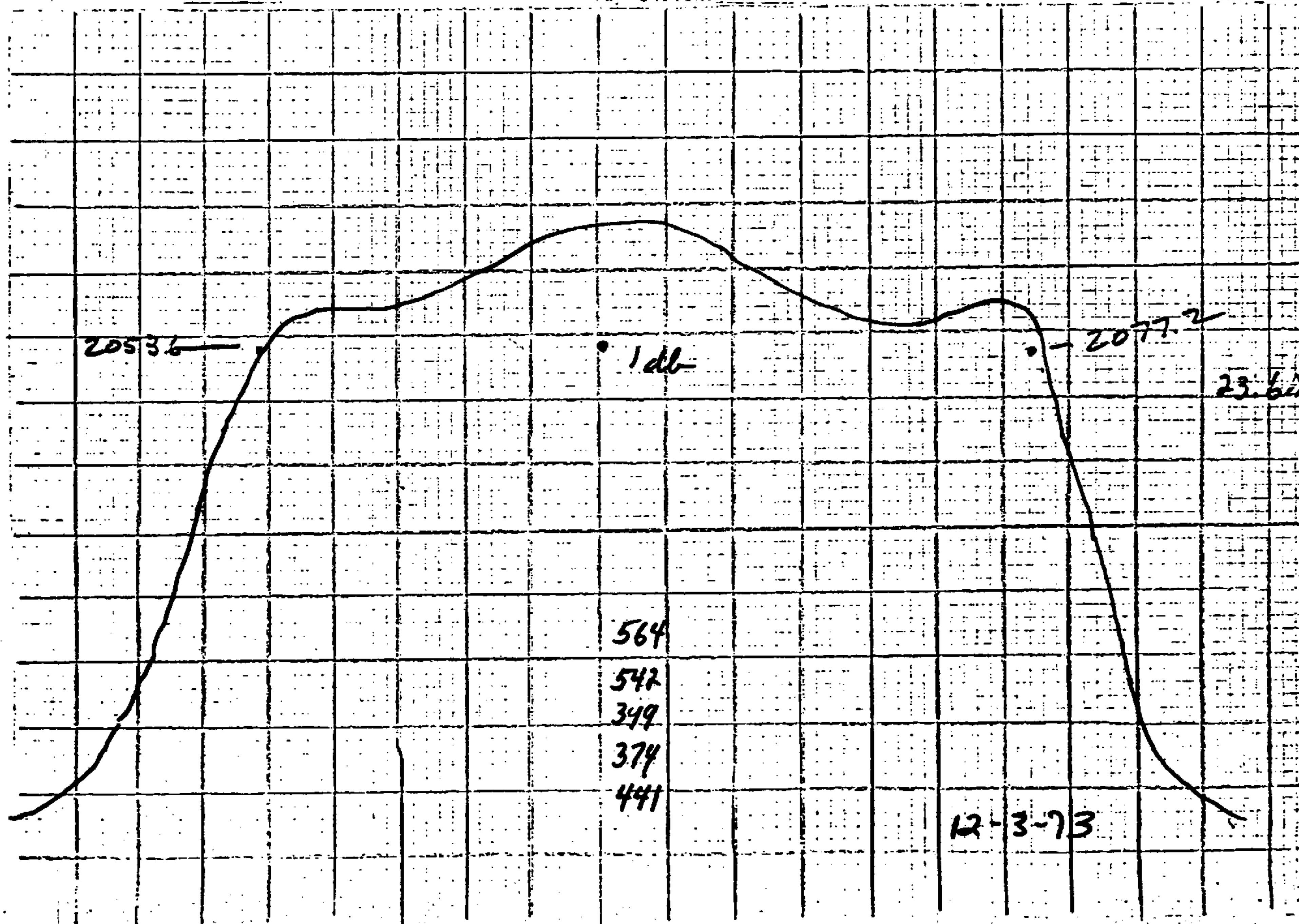


3

Filament voltage ______ V
Filament current ______ A
... current ______ A

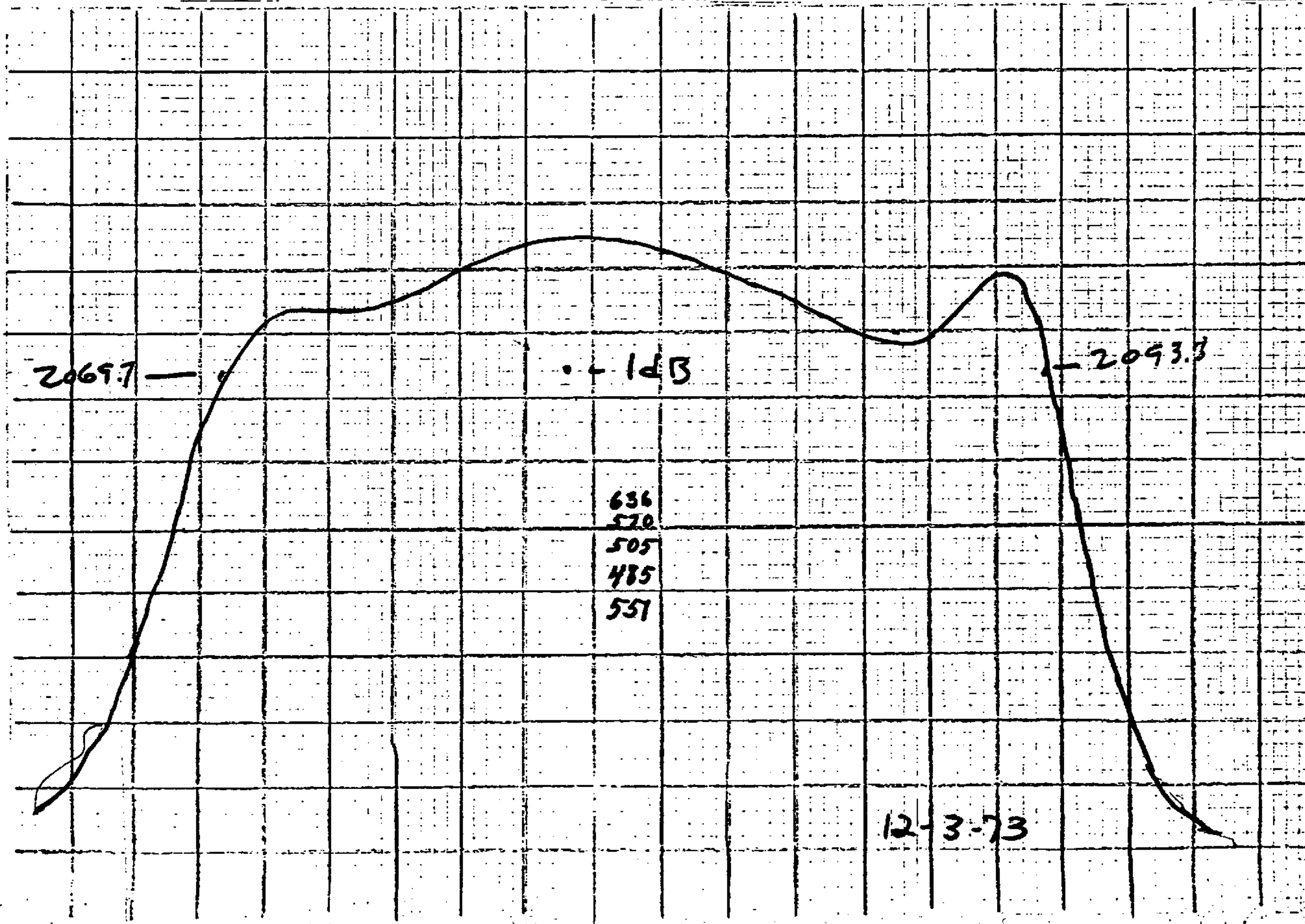
Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 10 k
Drive power ______
Gain ______ d



12-[illegible]-73

[illegible] voltage ______ V	4 [illegible] ______ kV	Power output 2 kW
[illegible] current ______ A	[illegible] current ______ A	Drive power ______ mW
[illegible] current ______ A	[illegible] current ______ mA	Gain ______ db



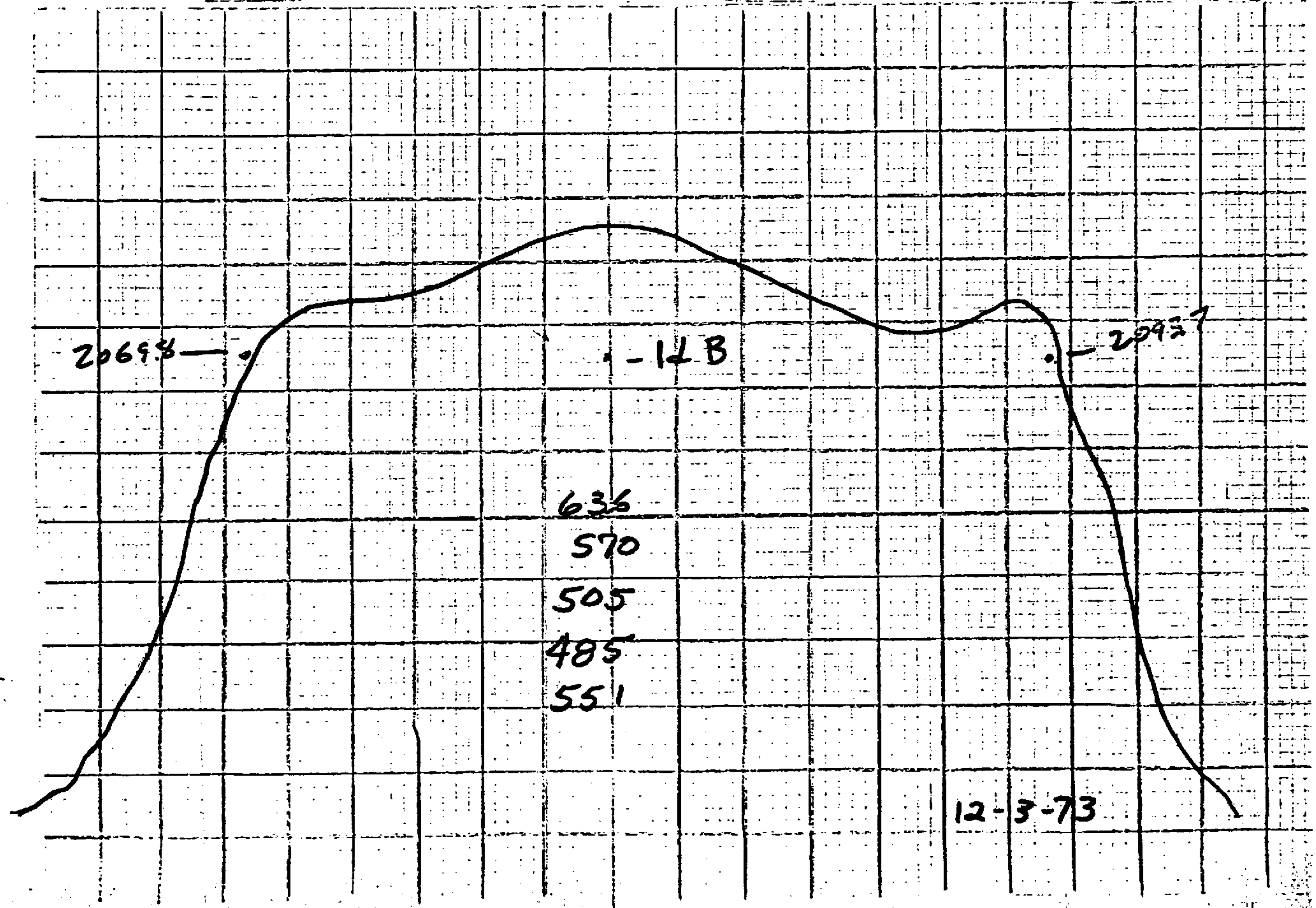
Date 12-[illegible]-73

Tube No. 4

Filament voltage ______ V
Filament current ______ A
Magnet current ______ A

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 10 kW
Drive power ______ W
Gain ______ dB



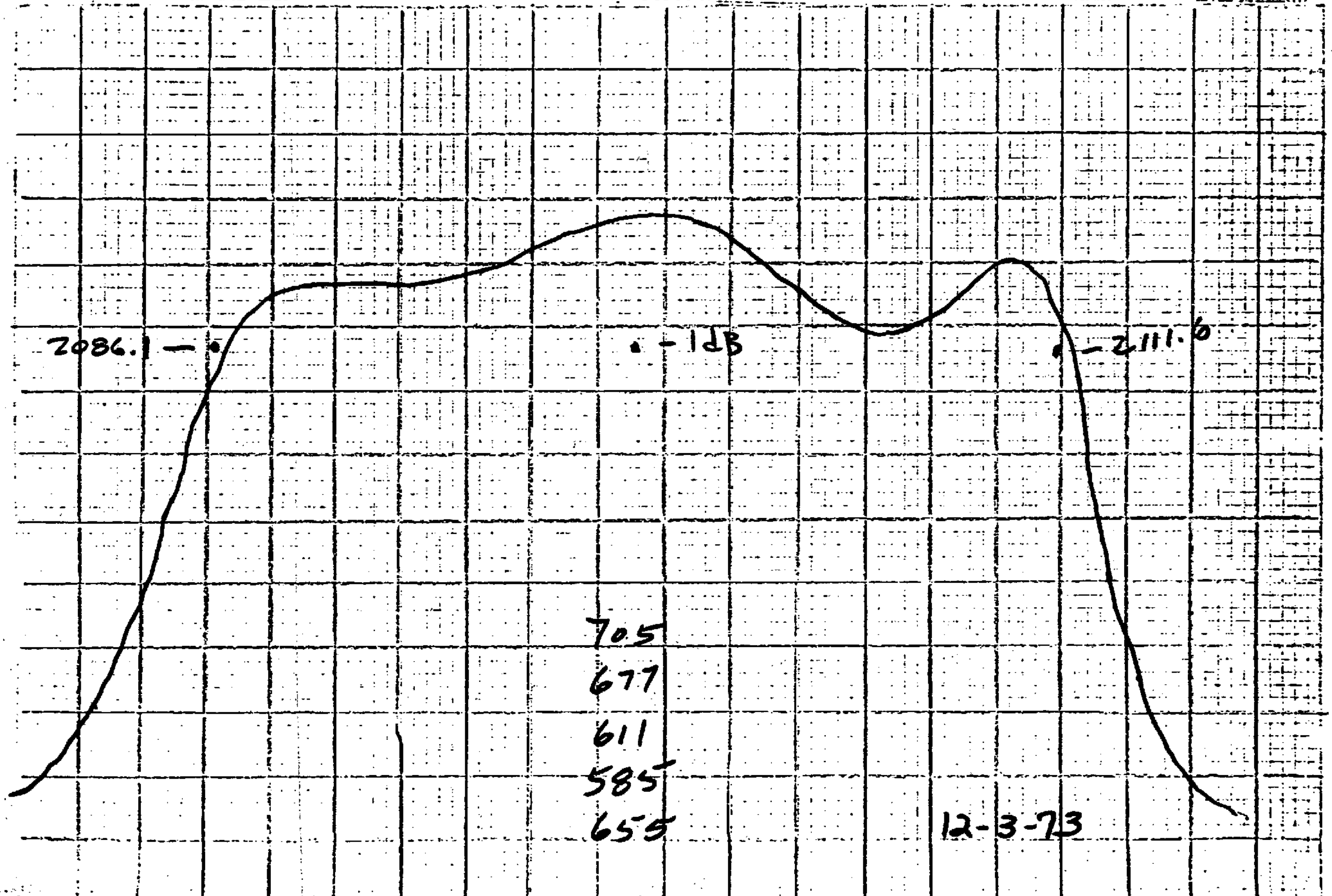
Date 12-3-7

Tube 5

Filament voltage ______ V
Filament current ______ A
Magnet current ______ A

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 2 kW
Drive power ______ mW
Gain ______ db



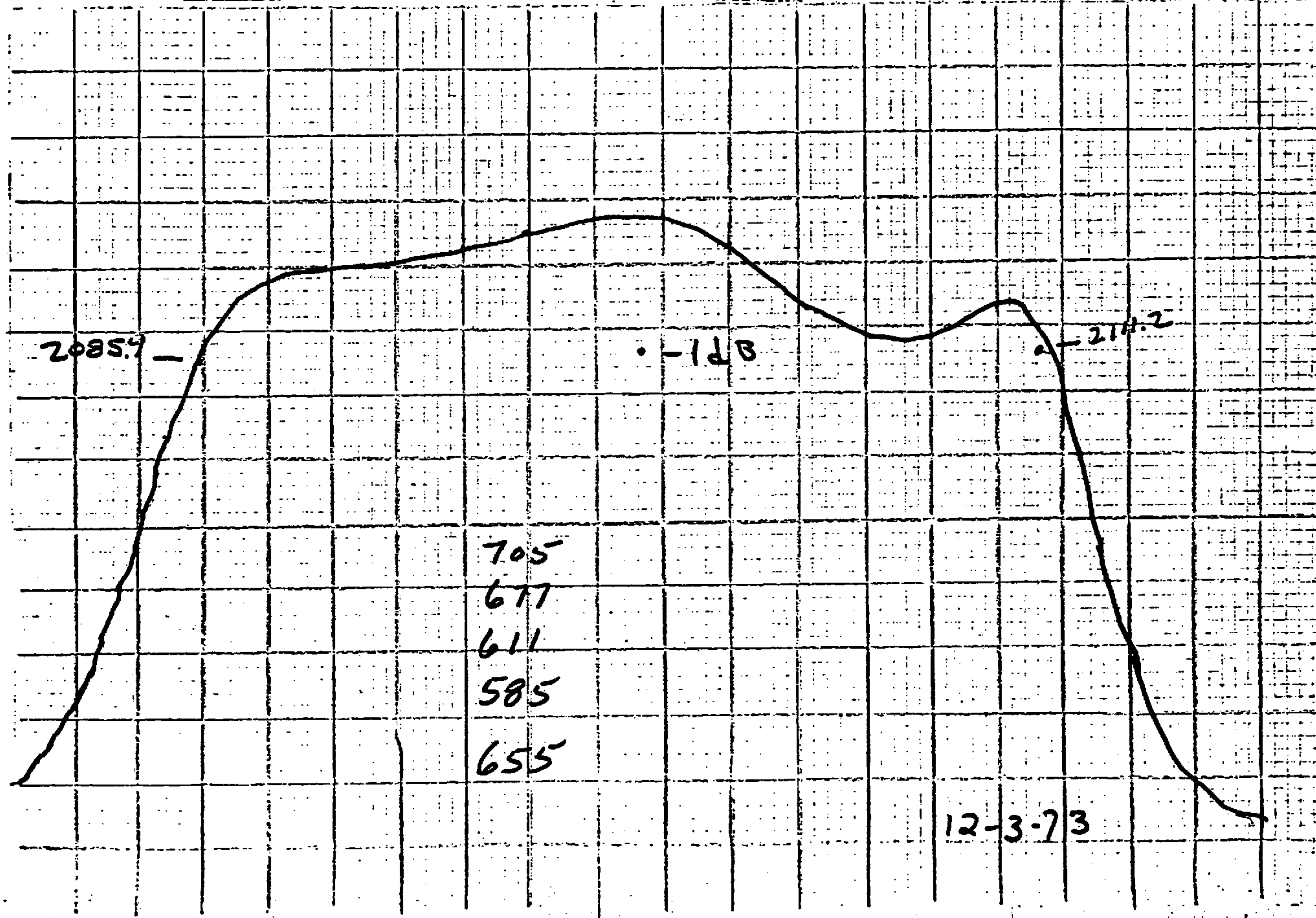
12-73

5

Filament voltage ______ V
Filament current ______ A
Magnet current ______ A

Beam voltage ______ kV
Beam current ______ A
Body current ______ mA

Power output 10 kW
Drive power ______ mW
Gain ______ db



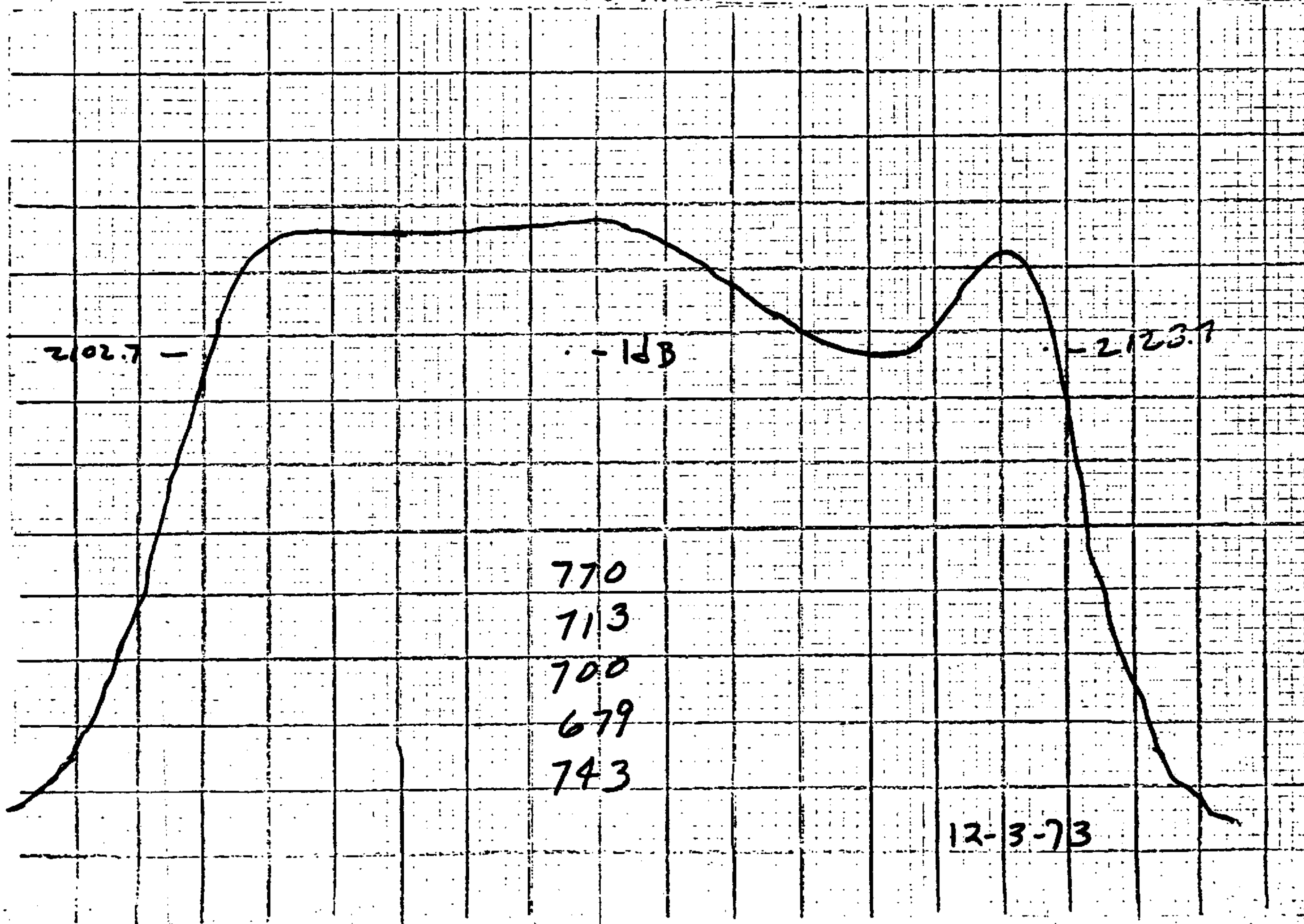
12●3-73

6

Filament voltage ________ V
Filament current ________ A
Magnet current ________ A

Beam voltage ________ kV
Beam current ________ A
Body current ________ mA

Power output __2__ kW
Drive power ________ W
Gain ________ dB

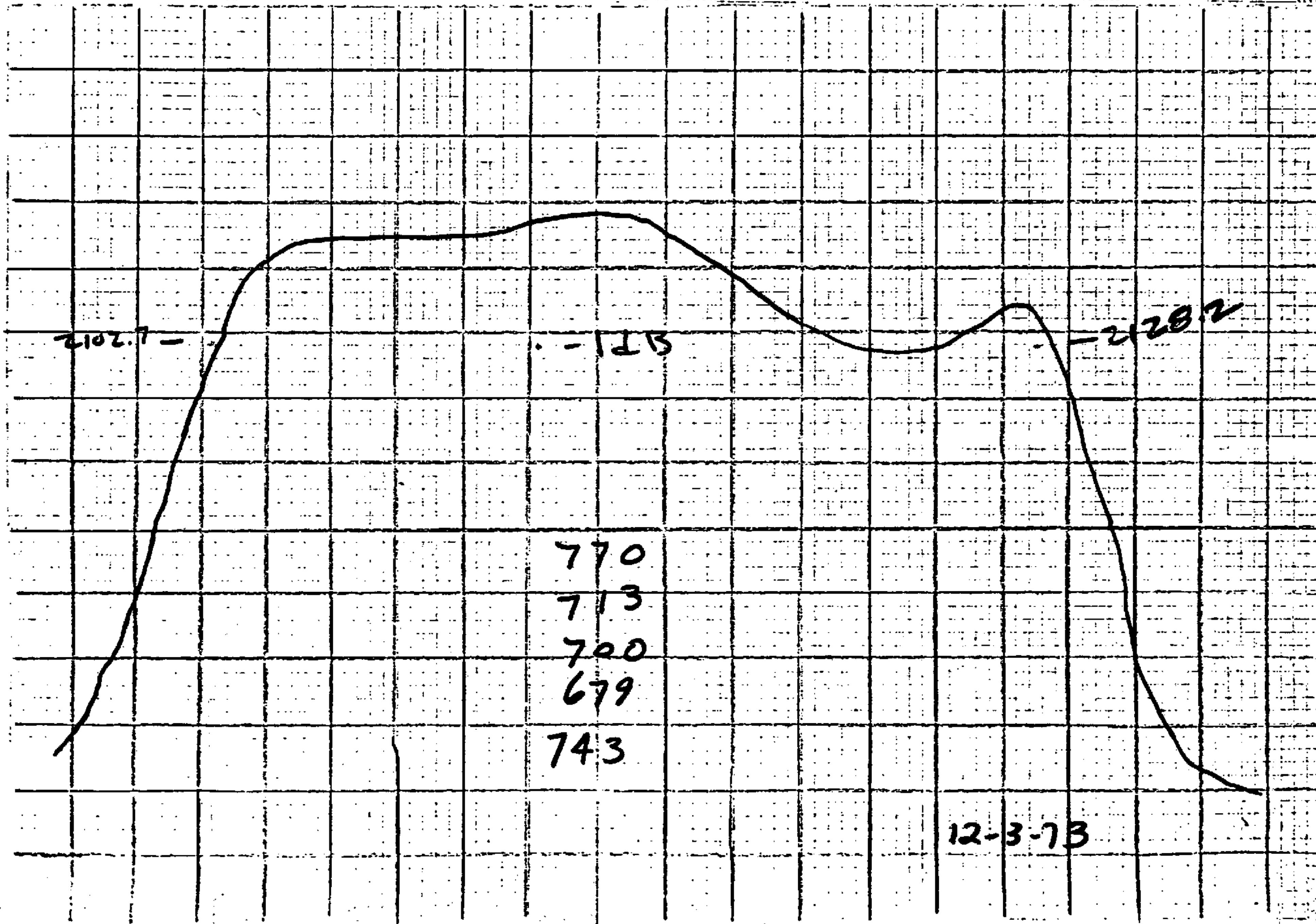


12-?-73

Filament voltage ________ V
Filament current ________ A
... current ________ A

... 6
... voltage ________ kV
Beam current ________ A
Body current ________ mA

Power output 10 kW
Drive power ________ W
Gain ________ db

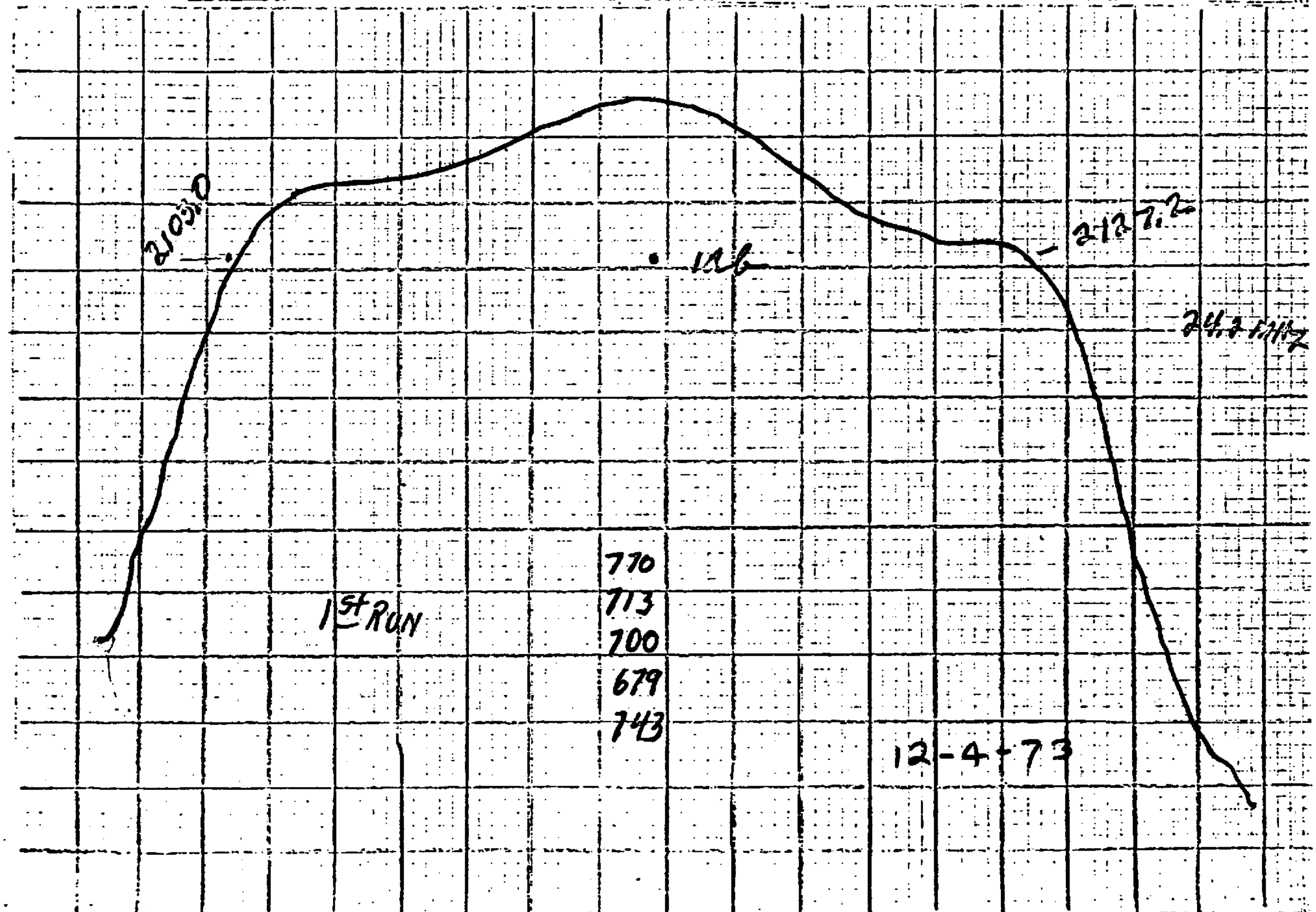


12-[illegible]-73

Filament voltage ________ V
Filament current ________ A
... current ________ A

Beam voltage __6__ kV
Beam current ________ A
Body current ________ mA

Power output __20__ kW
Drive power ________ W
Gain ________ dB

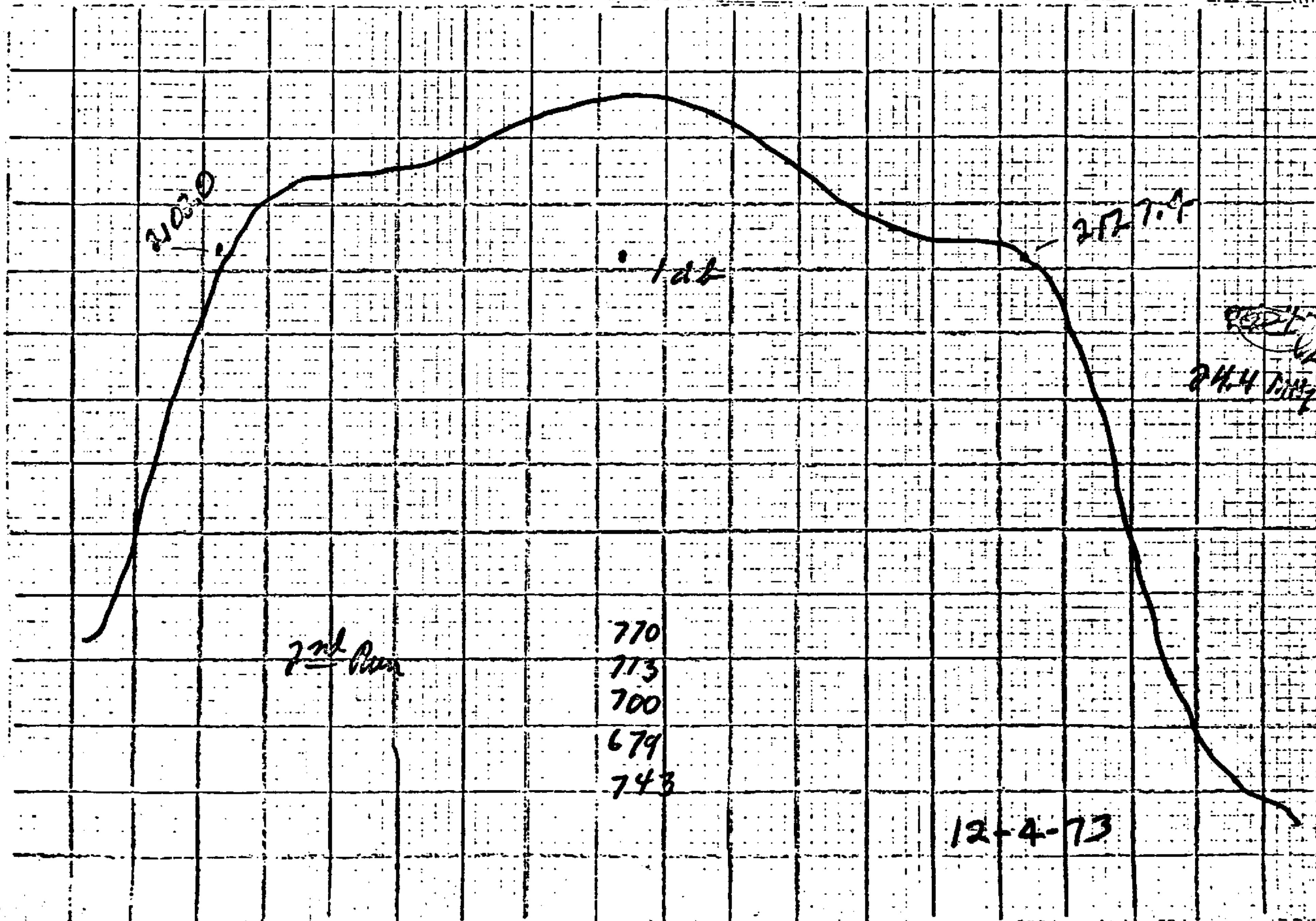


12- 73

Filament voltage ______ V
Filament current ______ A
[illegible] current ______ A

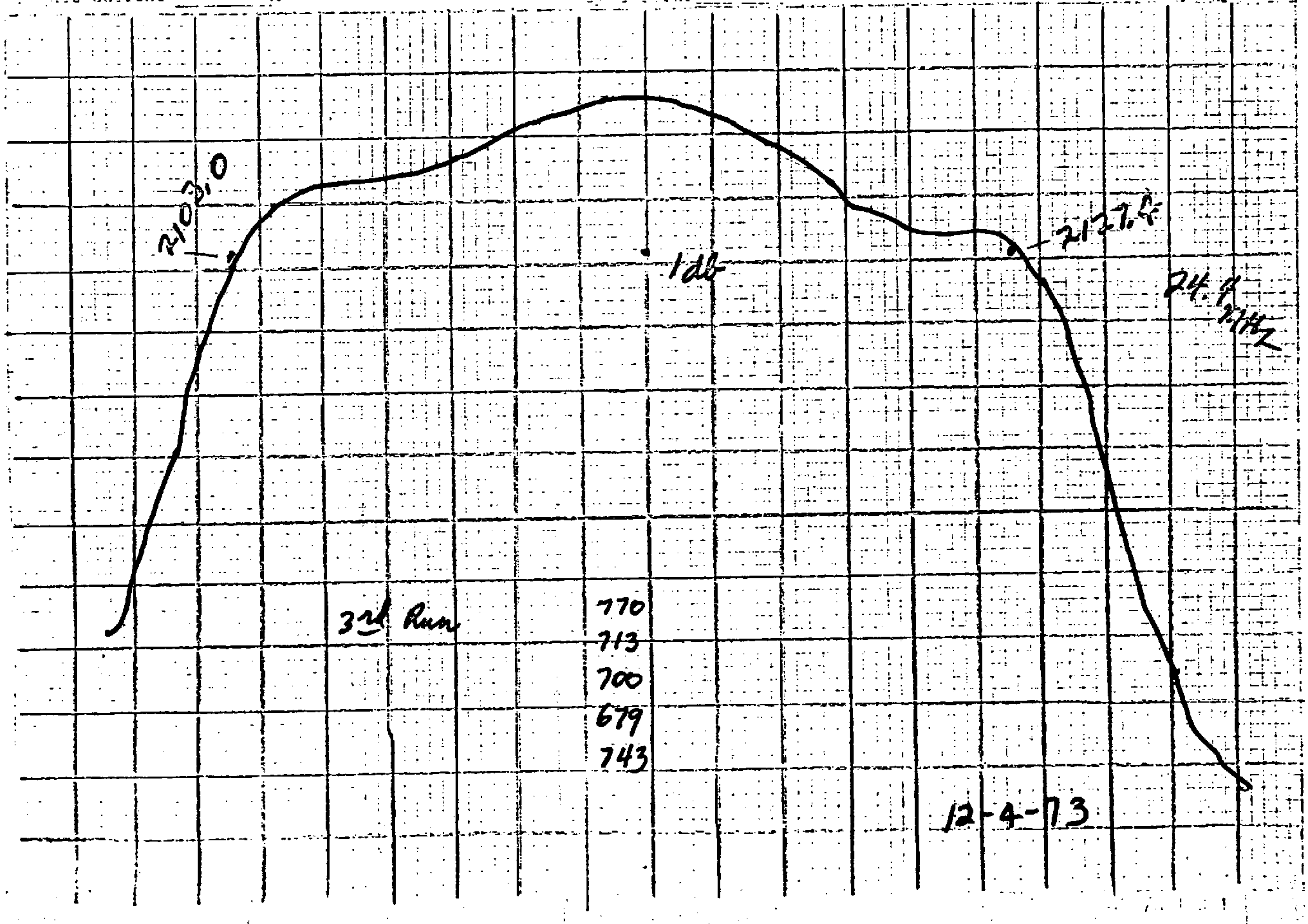
Beam voltage __6__ kV
Beam current ______ A
Body current ______ mA

Power output __20__ kW
Drive power ______ mW
Gain ______ db



12-4-73

...ment voltage ______ V	Beam voltage ___6___ kV	Power output ___20___ kW
...ment current ______ A	Beam current ______ A	Drive power ______ MW
...ned current ______ A	Body current ______ mA	Gain ______ db

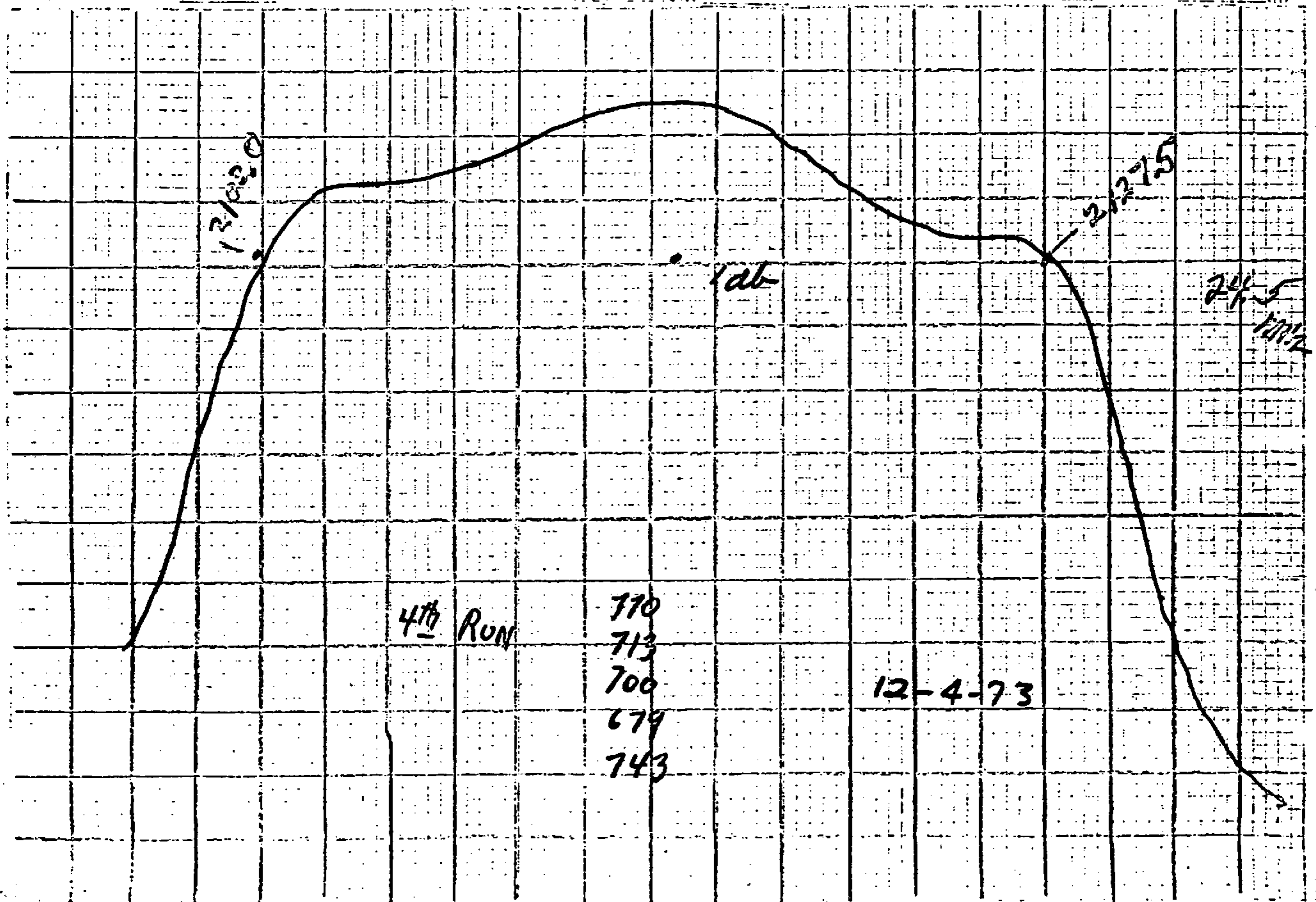


12-[illegible]-73

Filament voltage ______ V
Filament current ______ A
... current ______ A

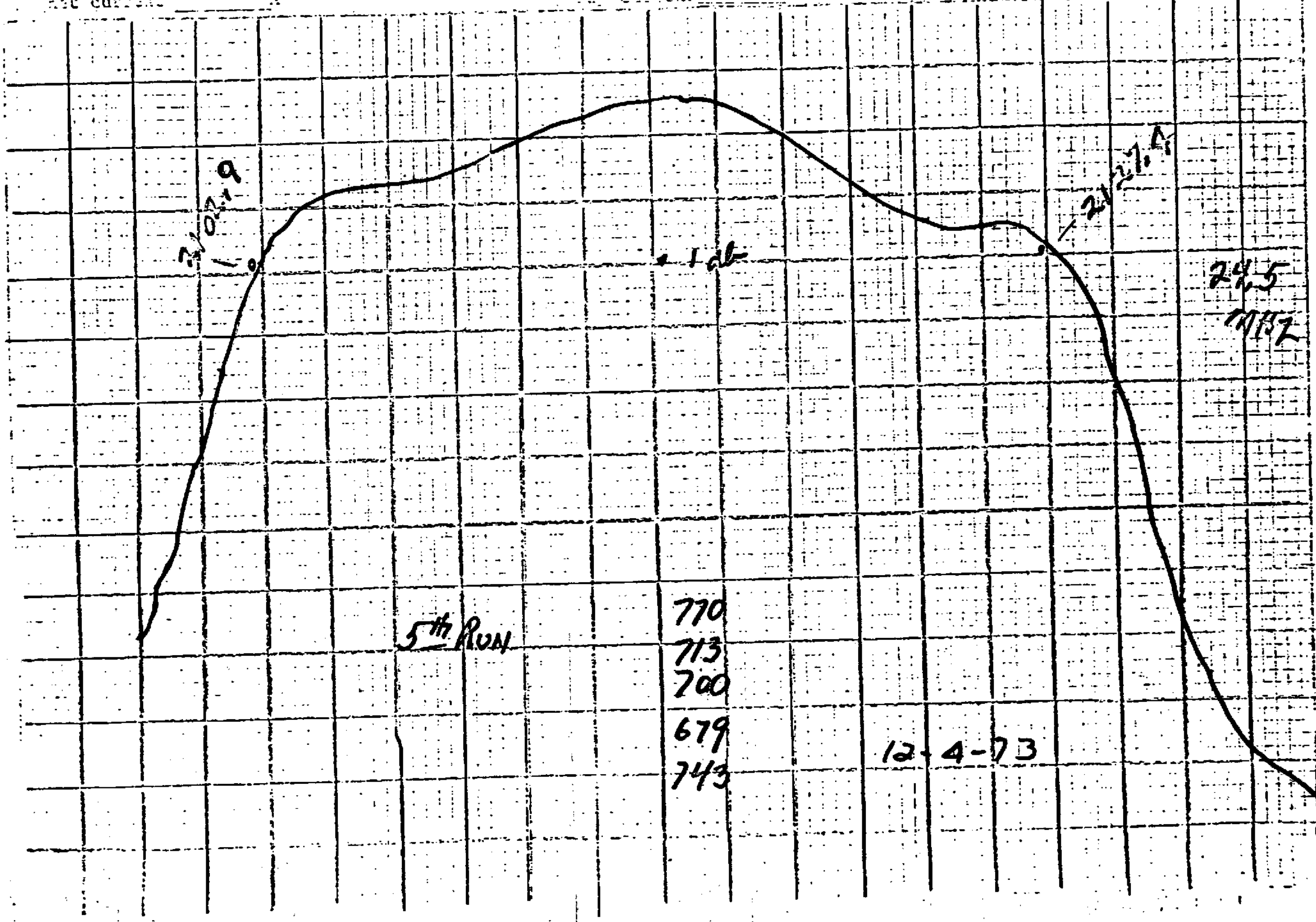
Beam voltage 6 kV
Beam current ______ A
Body current ______ mA

Power output 20 kW
Drive power ______ MW
Gain ______ db



12-47

Filament voltage ______	Beam voltage 6 kV	Power output 20 kW
Filament current ______ A	Beam current ______ A	Drive power ______ MW
... current ______ A	Body current ______ mA	Gain ______ db

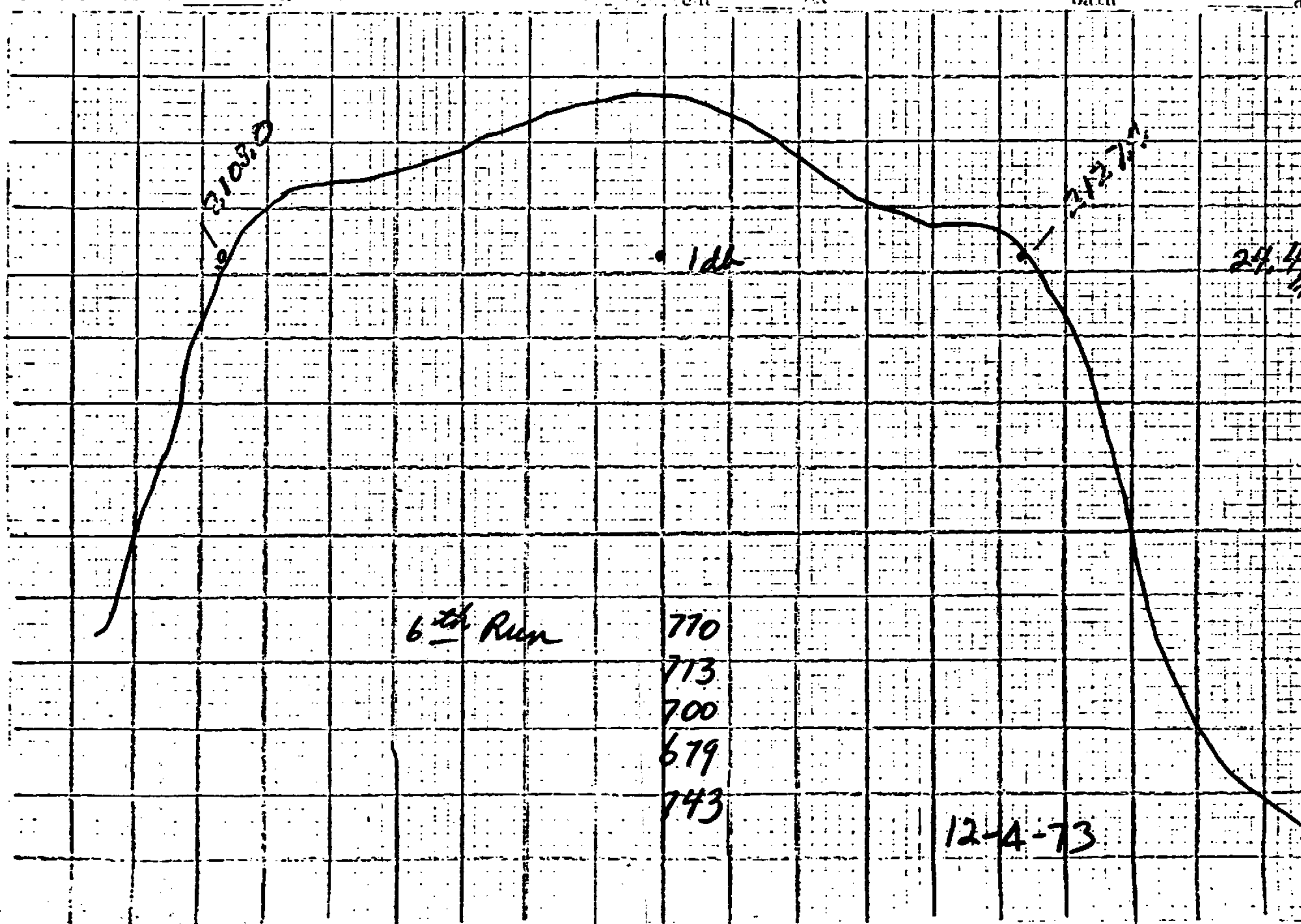


12[illegible]-73

Filament voltage ______ V
Filament current ______ A
[illegible] current ______ A

Beam voltage 6 kV
Beam current ______ A
Body current ______ mA

Power output 20 k
Drive power ______ W
Gain ______ d



WORK BOOK
July 26, 1973

FINAL ACCEPTANCE TEST PROCEDURE

FOR

VARIAN 5K70SK-WBT

PUBLICATION NO. 87-800-215

APPROVED:

R. S. Kellow   6-18-73
COLLINS RADIO COMPANY, ENGINEERING   DATE

COLLINS RADIO COMPANY, QUALITY ASSURANCE   DATE

Art Goldwinger   June 13, 1973
VARIAN ASSOCIATES, ENGINEERING   DATE

7/13/73
VARIAN ASSOCIATES, QUALITY ASSURANCE   DATE

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1.0 PURPOSE.

This document defines the parameters and methods required to assess the performance of a five cavity 24 kW, CW klystron amplifier, tunable over the 2025 to 2120 MHz band with a remote controlled six position channel tuner. The acceptance tests are written to the requirements of Collins Radio Company Drawing No. S-090-0046-257 and 090-0047-257.

The tests as delineated will not necessarily be performed in the order as presented in this document. A pre-requisite of performing acceptance testing is that sufficient preliminary testing has been accomplished to define electrical parameters and assess general tube performance.

2.0 EQUIPMENT REQUIREMENTS

The test equipment given in Paragraph 2.2, or its equivalent, will be used in the acceptance testing of the 5K70SK-WBT and remote controlled six position channel tuner.

2.1 Equipment Calibration

The calibrations and control of the test equipment will be performed by Instrument Services under the direction of Quality Assurance. Controls and procedures for calibration are specified in Quality Assurance Operating Procedure 87-800-154 and Instrument Services Operating Manual 87-800-153.

2.2 Equipment List

ID No.	Description	Manufacturer	Type Or Model	Frequency of Calibration	Percent Accuracy
1	Sweep Oscillator	Hewlett-Packard	692B	N/A	
2	Microwave Amplifier	Hewlett-Packard	491C	N/A	
3	Low Pass Filter	Microlab/FXR	LA-30N	N/A	
4	Variable Attenuator	Narda	792FF	N/A	
5	Frequency Meter	Hewlett-Packard	536A	1 year	± 0.08
6	Dual-Directional Coupler	Hewlett-Packard	767D	1 year	± 1.0
7	Isolator	Sperry	D-44S5	N/A	
8	Thermistor	Hewlett-Packard	478A	N/A	
9	Power Meter	Hewlett-Packard	431C	3 mo.	± 5.0 FS
10	3 Port Rf Sampler	Varian	Special	N/A	
11	Water Load	Eimac	WL-204	N/A	
12	Thermometer Set	Varian	Special	1 year	± 1.0
13	Low Pass Filter	Microlab/FXR	LA-30N	N/A	
14	Variable Attenuator	Narda	791FM	N/A	
15	Spectrum Analyzer	Hewlett-Packard	8555	3 mo.	± 3.0
16	Oscilloscope Camera	Hewlett-Packard	197A	N/A	
17	Low Pass Filter	Microlab/FXR	LA-30N	N/A	
18	Variable Attenuator	Narda	792FF	N/A	
19	Thermistor	Hewlett-Packard	478A	N/A	
20	Power Meter	Hewlett-Packard	431C	3 mo.	± 5.0 FS
21	Low Pass Filter	Microlab/FXR	LA-30N	N/A	
22	10 dB Attenuator	Weinschel	530-10	N/A	
23	Crystal Detector	Hewlett-Packard	420A	N/A	
24	Oscilloscope	Tektronix	545A	3 mo.	± 3.0
25	Collector Flow Meter	Fisher and Porter	0-40 gpm	3 mo.	± 2.0 FS
26	Body Flow Meter	Fisher and Porter	0-4 gpm	3 mo.	± 2.0 FS

2.2 Equipment List (cont'd)

ID No.	Description	Manufacturer	Type Or Model	Frequency of Calibration	Percent Accuracy
27	Pressure Gauge	J.P. Marsh	0-100 psi	3 mo.	± 2.0 FS
28	Focusing Magnet	Varian	H-193	N/A	
29	Heater-Magnet-H.V. Power Supply	Eimac	11919	3 mo.	± 2.0 FS (See mete accuracy list)
30	Pressure Fixture	Varian	0-300 psi	3 mo.	± 2.0 FS
31	Torque Wrench	Waters	940-2	3 mo.	± 5.0 FS
32	Signal Generator	Rhode & Schwartz	SLRD	N/A	
33	Directional Coupler	Narda	3043-10	N/A	
34	Water Load Flow Meter	Fisher and Porter	0-14 gpm	3 mo.	± 2.0 FS
35	S-Band TWT	Varian	VTS-6050	N/A	
36	Preselector	Hewlett-Packard	8445A	N/A	
37	W/G to Coax Adapter	Narda	615	N/A	

2.3 Meter Accuracies for Power Supply No. 11919

NAME	MANUFACTURER	TYPE OR MODEL	RANGE	PERCENT ACCURACY
Heater Voltage	Westinghouse	DY-2	0-15 Vac	± 2.0 FS
Heater Current	Westinghouse	DY-2	0-50 Aac	± 2.0 FS
Beam Voltage	Westinghouse	DX	0-25 kVdc	± 1.0 FS
Body Current	Assembly Products	461	0-500 mAdc	± 2.0 FS
Beam Current	Weston	301	0-3 Adc	± 1.0 FS
Magnet Current	Opad Electric	0-25	Adc	± 2.0 FS

3.0 APPLICABLE DOCUMENTS

Collins Radio Company Drawing No. 090-0046-257 (Klystron)

Collins Radio Company Drawing No. 090-0047-257 (Tuner)

Palo Alto Tube Division Quality Assurance Operating Procedure Manual

Technical Manual S-Band Klystron Power Amplifier Subsystem Model 11-076

4.0 KLYSTRON INSTALLATION PROCEDURE

For detailed installation procedure refer to Technical Manual S-Band Klystron Power Amplifier Subsystem Model 11-076.

5.0 DESCRIPTION OF TESTS

5.1 Test: Hydrostatic Pressure

Procedure: Fill the body and collector coolant lines with coolant and pressurize to 125 psi.

RECORD OBSERVATIONS

Verification: There shall be no evidence of coolant leakage.

5.2 Test: Body Coolant Pressure Drop

Procedure: Connect a differential pressure gauge across the body coolant lines. Set the flow rate at 1.2 gpm and read the pressure drop.

RECORD PRESSURE DROP

Verification: The pressure drop shall not exceed 65 psi.

5.3 Test: Collector Coolant Pressure Drop

Procedure: Connect a differential pressure gauge across the collector coolant lines. Set the flow rate at 18.5 gpm and read the pressure drop.

RECORD PRESSURE DROP

Verification: The pressure drop shall not exceed 40 psi.

5.4 Test: Heater Current

Procedure: Apply heater voltage and adjust to 7.5 volts. The surge current should not exceed 24 amperes. After five minutes, read the heater current.

RECORD HEATER CURRENT

Verification: The heater current shall not fall below 9.5 amperes nor exceed 13.0 amperes.

5.5 Test: Tuner Torque

Procedure: Tune each cavity over its specified range (see tuning curves) using a 0-100-inch-ounce torque wrench tool. Observe the maximum torque encountered.

RECORD MAXIMUM TORQUE

Verification: The torque required to tune the tube shall not exceed 80-inch-ounces.

5.6 Test: Focusing

Procedure: The klystron shall be electromagnetically focused by the H-193 electromagnet assembly. The voltage source shall not exceed 200 volts. The optimum value shall be determined during preliminary testing. This optimum value will be used throughout the series of tests.

RECORD FOCUS VOLTAGE AND CURRENT

Verification: The focus current shall not exceed 25 amperes.

5.7 Test: Beam Voltage

Procedure: Apply heater voltage as per Paragraph 5.4. Apply voltage to the electromagnet assembly and adjust to specified value. Apply beam voltage and adjust to specified value.

RECORD BEAM VOLTAGE

Verification: The beam voltage shall not fall below 7.0 kV nor exceed 22.0 kV.

5.8 Test: Cathode Current

Procedure: Operate the klystron as per paragraph 5.7. Allow 5 minutes for the current to stabilize.

RECORD CATHODE CURRENT

Verification: The cathode current shall not exceed 2.78 Adc.

5.9 Test: Emission

Procedure: Operate klystron as per Paragraph 5.7 for 15 minutes, after which the heater voltage shall be reduced to 6.75 volts. After 15 minutes of stabilization at the reduced heater voltage, the beam current shall be measured.

RECORD CHANGE IN BEAM CURRENT

Verification: The change in beam current shall not exceed 200 mA.

5.10 Test: Collector Dissipation

Procedure: Operate klystron at Ef = 7.5 V, Eb = 22 kV, Pd = 0, collector coolant flow = 13 gpm or less. Listen for collector coolant boiling and monitor for internal arcing for a minimum of 15 minutes.

RECORD OBSERVATIONS

Verification: The tube shall operate without arcs and the collector coolant shall not boil.

5.11 Test: Power Output

Procedure:

Step 1 Connect equipment as shown in Figure 6.1 and operate per Paragraph 5.7.

Step 2 Actuate tuning mechanism to achieve tuning for Channel 1.

Step 3 Increase rf drive and observe output response with crystal detector.

Step 4 Switch sweep selector to manual.

Step 5 Adjust rf drive power level and rf drive frequency to achieve rated power output at point of maximum power output.

Step 6 Set recorder Y-axis to record drive level.

Step 7	Set sweep time to ten seconds.
Step 8	Record drive levels to 0 dB and - 1.0 dB and leave attenuator set for 0 dB level.
Step 9	Disconnect Y axis of recorder from drive power bridge and connect to output power bridge.
Step 10	Set sweep selector to manual and adjust frequency to point of highest power output.
Step 11	Observe water load temperature differential and calculate power output.
Step 12	Record power output.
Step 13	Adjust output attenuator to produce a point on the recorder Y axis to coincide with the 0 dB line drawn in Step 8.
Verification:	The power output shall not be less than 24 kW measured on the highest point within the specified bandwidth.
Step 14	Record output trace.
Step 15	Calibrate the X axis in 2 MHz steps using frequency meter and manual sweep.
Step 16	Repeat Steps 2 through 14 for Channels 2 through 6.
Step 17	Repeat Steps 2 through 14 for Channels 1 through 6 with beam voltage and drive adjusted to achieve 1 kW power output.

5.12 Test: Bandwidth (1 dB)

Procedure: From graphs obtained in Paragraph 5.11 determine 1 dB bandwidth.

RECORD BANDWIDTH

Verification: The bandwidth measured at the 1 dB point shall not fall below 22 MHz.

5.13 Test: Gain

Procedure: While operating as per Paragraph 5.11, compute the rf gain (10 x log power out/drive).

RECORD GAIN

Verification: This gain shall not fall below 45 dB at the 24 kW level. No more than 750 milliwatts will be required within the 24 kW to 1 kW range.

5.14 Test: Efficiency

Procedure: While operating as per Paragraph 5.11, compute the efficiency: $\frac{\text{rf power output}}{\text{dc power input}}$

RECORD EFFICIENCY

Verification: The efficiency shall not fall below 39% at the 24 kW level.

5.15 Test: Warm-up Time

Procedure: Operate klystron as per Paragraph 5.11, allowing a maximum of 5 minutes heater warm-up.

OBSERVE POWER OUTPUT

Verification: The tube shall produce rated output power.

5.16 Test: Body Current

Procedure: Observe klystron as per Paragraph 5.11 and observe body current.

RECORD BODY CURRENT

Verification: The body current shall not exceed 75 mAdc.

5.17 Test: Amplitude Response

Procedure: From graphs obtained in Paragraph 5.11 determine the maximum amplitude variation over center 22 MHz of bandpass.

RECORD AMPLITUDE VARIATION

Verification: The tube amplitude response shall not vary more than ± 0.5 dB, (1.0 dB peak-to-peak) over the center 22 MHz of the bandpass.

5.18 Test: Linearity

Procedure: With the klystron tuned to Channel 3 and operating as per Paragraph 5.7, apply drive signals of 2063 MHz and 2067 MHz such that the power output for each frequency is 2.38 kW. Measure the third order intermodulation products on the spectrum analyzer.

RECORD INTERMODULATION PRODUCTS

Verification: The third order intermodulation products shall not be less than 30 dB below the 2.38 kW level.

5.19 Test: Interface

Procedure: The klystron shall be mechanically interchangeable with the 5K70SG.

OBSERVE INTERCHANGEABILITY

Verification: All electrical connections, waveguides, coaxial jacks coolant fittings, etc. shall interface identically with the 5K70SG.

5.20 Test: Tuning

Procedure: Connect equipment as shown in Figure 6.1 and attach ohmmeter to drive interlock connections. Operate klystron per Paragraph 5.7. Actuate tuner to sequentially tune Channels 1 thru 6 and back to Channel 1. During tuner operation, visually observe the following:

1. Contact closure of drive interlock relay during tuning interval and return to "Open" at completion of tuning interval.
2. Time required to complete each tuning cycle.
3. Achievement of correct operating bandpass at completion of tuning cycle.
4. Operation of status lights to indicate selected channel and when tuning is in process.

Verification: The tuner shall be capable of achieving tuning to any selected channel in not more than 30 seconds. Status lights will indicate selected channel and tuning in process. Drive interlock relay will actuate during tuning cycle.

5.21 Test: Spurious Outputs

Procedure: Set up equipment as shown in Figure 6.3.

NOTE: Make certain that input to klystron is terminated.

1. Connect thermistor mount to waveguide to coax transition on klystron output.
2. Operate the klystron per Paragraph 5.7 with tuner set for Channel 3.
3. Measure R. F. power output on power bridge.
4. Calculate noise figure using the following formula:

$$\text{N.F. dB} = P_n\ (\text{dBm}) + 174\ \text{dBm} - G\ (\text{dB}) - BW\ (\text{dB})$$

Where Pn is Measured Output Noise Power

G is Small Signal Gain

BW is 3dB Bandwidth in Cycles

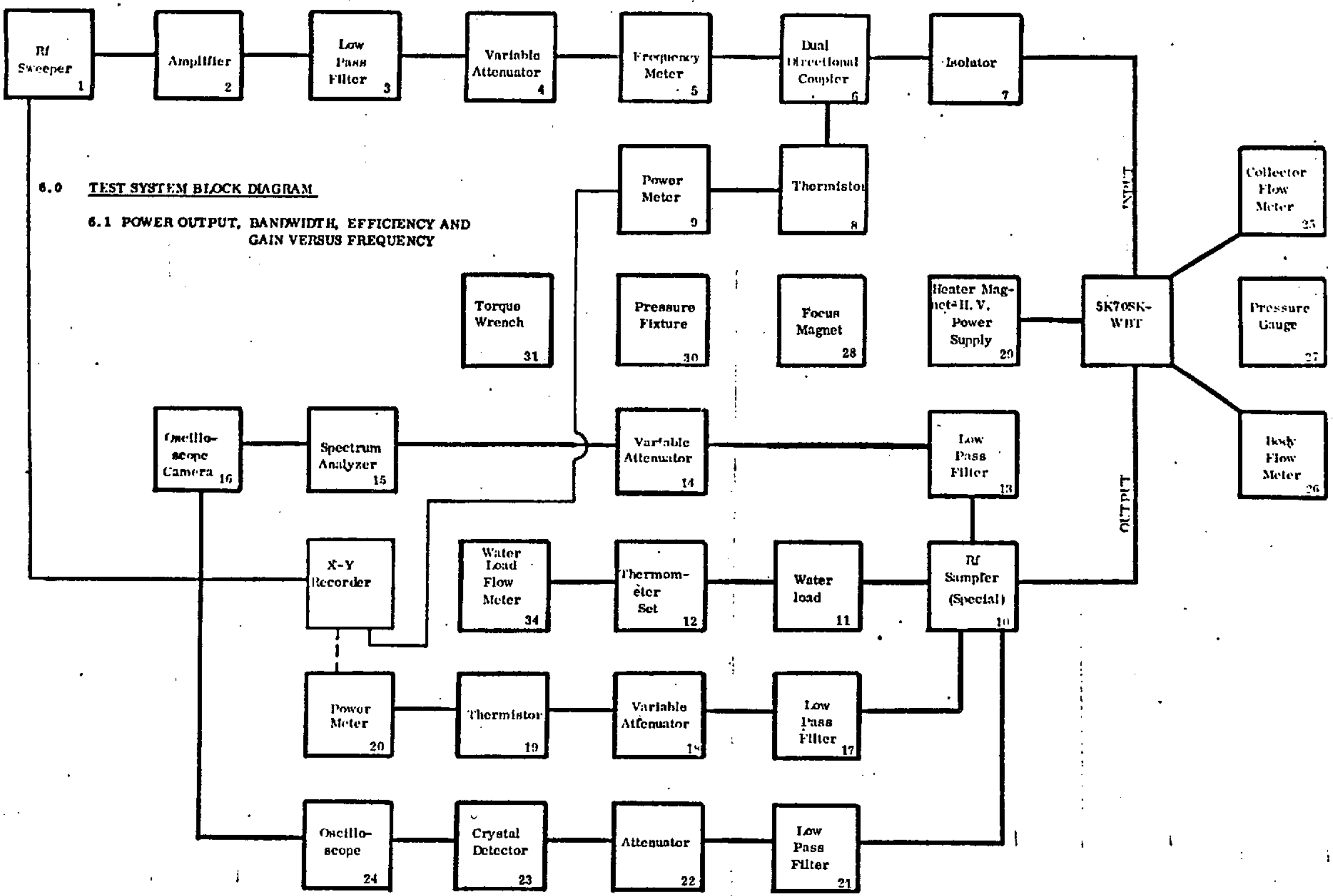
5. Reduce beam voltage to zero.
6. Remove thermistor mount and replace with input to tracking preselector.
7. Raise beam voltage for operation per Paragraph 5.7.
8. Set frequency range on spectrum analyzer for band from 1.5 GHz to 3.55 GHz.
9. Manually tune spectrum analyzer through this frequency range and observe display for any signals greater than 30 dB above thermal.
10. Switch spectrum analyzer for band 2.60 GHz to 4.65 GHz.
11. Repeat Step 9.

Verification: The noise figure shall be less than 35 dB at frequencies within ± 50 MHz of the tuned center frequency. At frequencies removed by more than 500 MHz, the output noise level shall not be greater than 30 dB above thermal.

NOTE: Calibration of the preselector - low noise TWT amplifier and spectrum analyzer will be accomplished by use of a coherent signal. Since the allowable noise power output from the klystron is 30 dB above thermal noise the calibrating signal will be adjusted to have a magnitude equal to a 30 dB noise figure source when detected in a bandwidth equal to the measurement bandwidth (I.F. bandwidth) of the spectrum analyzer. As an example: using 100 KHz I.F. bandwidth on the spectrum analyzer the magnitude of the calibrating signal would be -174 dBm/Hz (thermal noise) + 30 dB (allowable noise figure) + 50 dB (10 log 100,000 Hz) or -94 dBm.

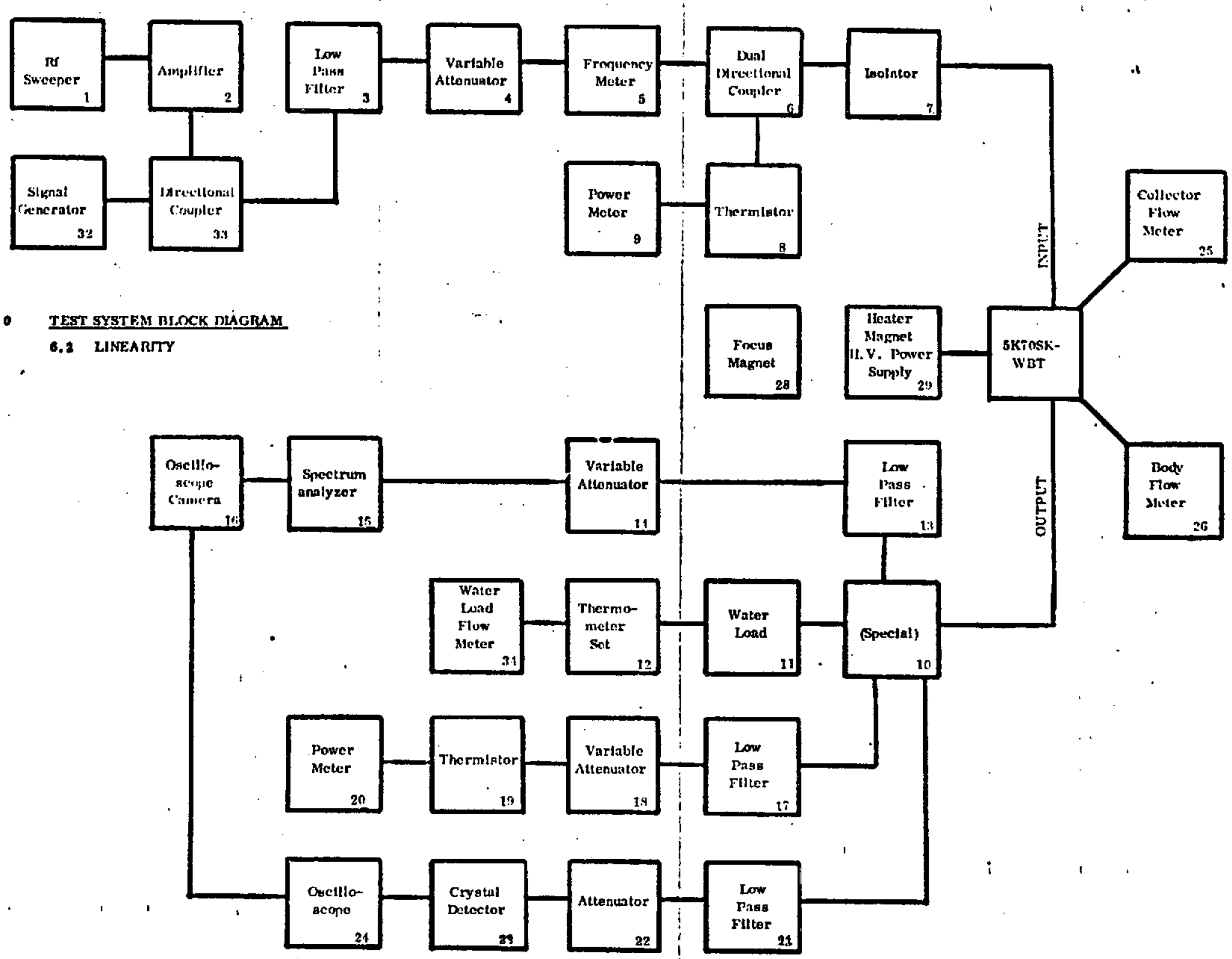
6.0 TEST SYSTEM BLOCK DIAGRAM

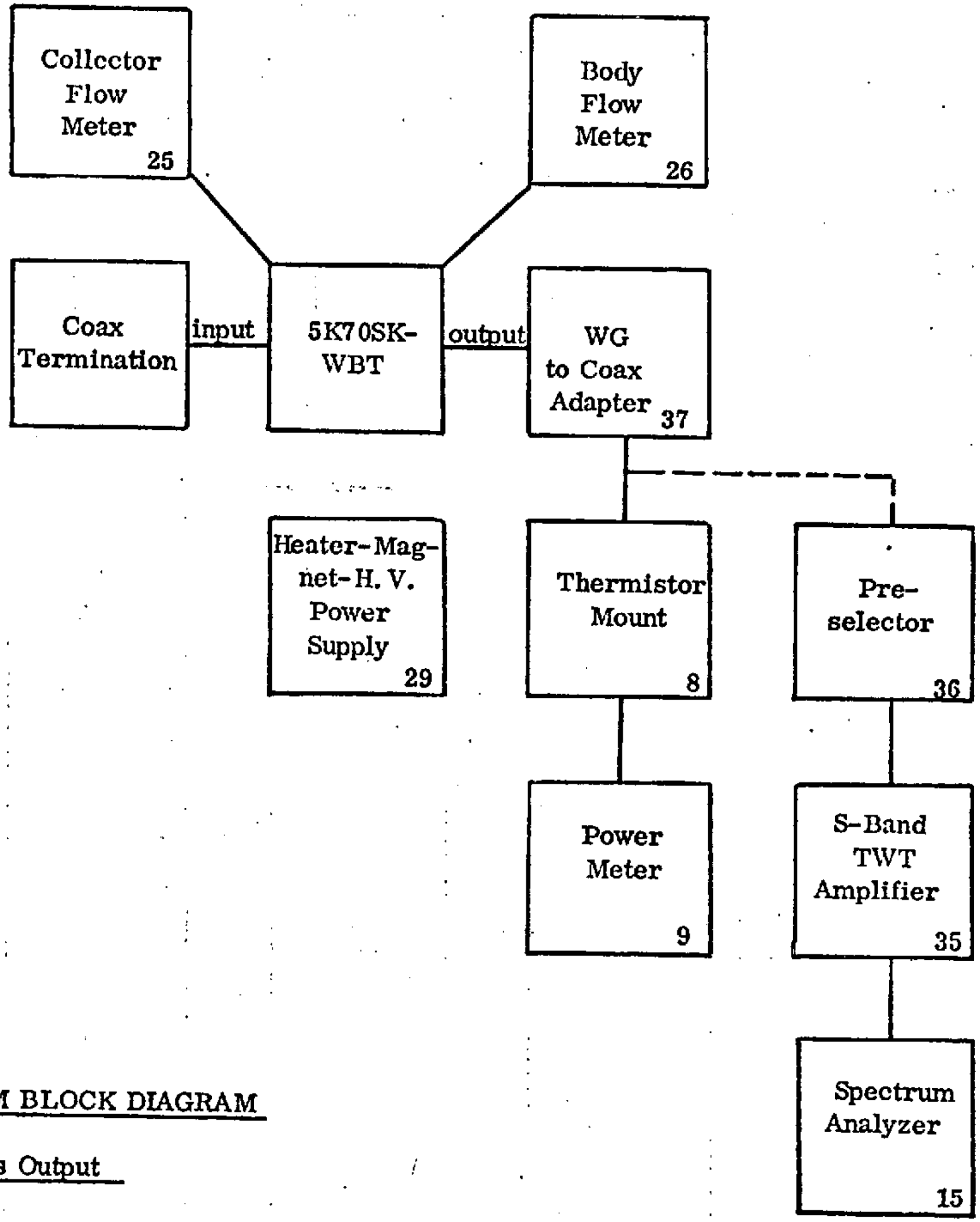
6.1 POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN VERSUS FREQUENCY



6.0 TEST SYSTEM BLOCK DIAGRAM

6.2 LINEARITY





6.0 TEST SYSTEM BLOCK DIAGRAM

6.3 Spurious Output

5K70SK-WBT

S/N 1

KLYSTRON

CHANNEL NO. 1 25KW

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2031	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.75	---	2.78	Adc
Collector Dissipation	P_{col}:	60.5	---	70	kW
Power Output	Po:	25.0	24	---	kW
Rf Input Power	Pd:	440	---	750	mW
Efficiency	E_{ff}:	41.4	39	---	%
Gain	Gain:	47.5	45	---	dB
Body Current	Iby:	21.0	---	75	mAdc
Bandwidth	Bw:	23.5	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.9	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	17.7	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	ΔG:	< 0.5	---	± 0.5	dB
Spurious Output	NF	< 35	---	35	dB

Tested By: Art Goldfinger Date July 30, 1973

Varian QAR [illegible] Date [illegible] 1973

Customer QAR ____________ Date ____________

A	B	C	D	E
370	234	128	098	163

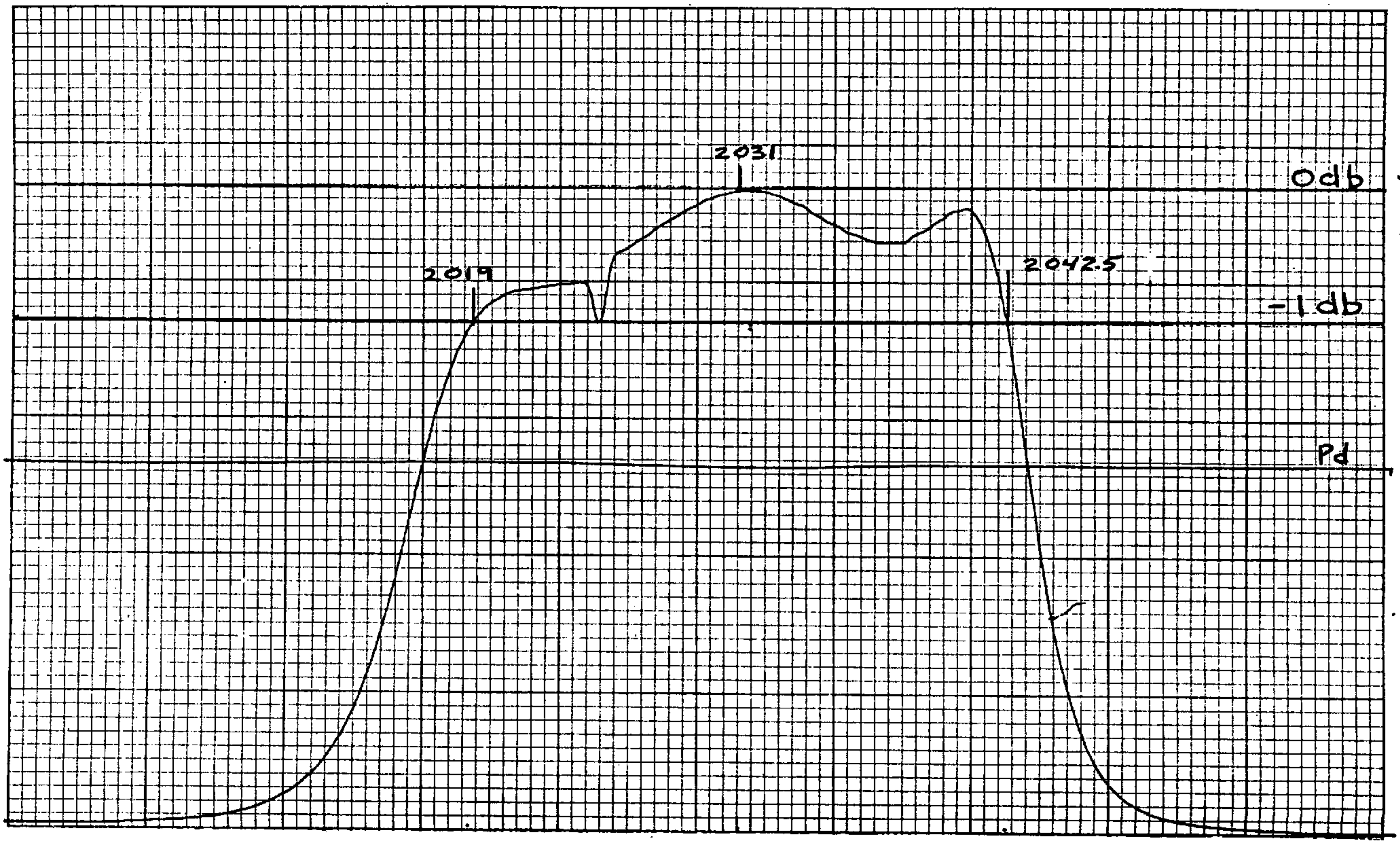
4240-10-28 8/72
TEST DATA SHEET

SK70SK WBT SERIAL NO. 1 CHANNEL 1 DATE: JULY 30 '73 BY: AAG

FILAMENT VOLTAGE 7.5 V
FILAMENT CURRENT 11.9 A
MAGNET CURRENT 17.7 A

BEAM VOLTAGE 22 kV
BEAM CURRENT 2.75 A
BODY CURRENT 21 mA

POWER OUTPUT 25 kW
DRIVE POWER 440 mW
GAIN 47.5 dB

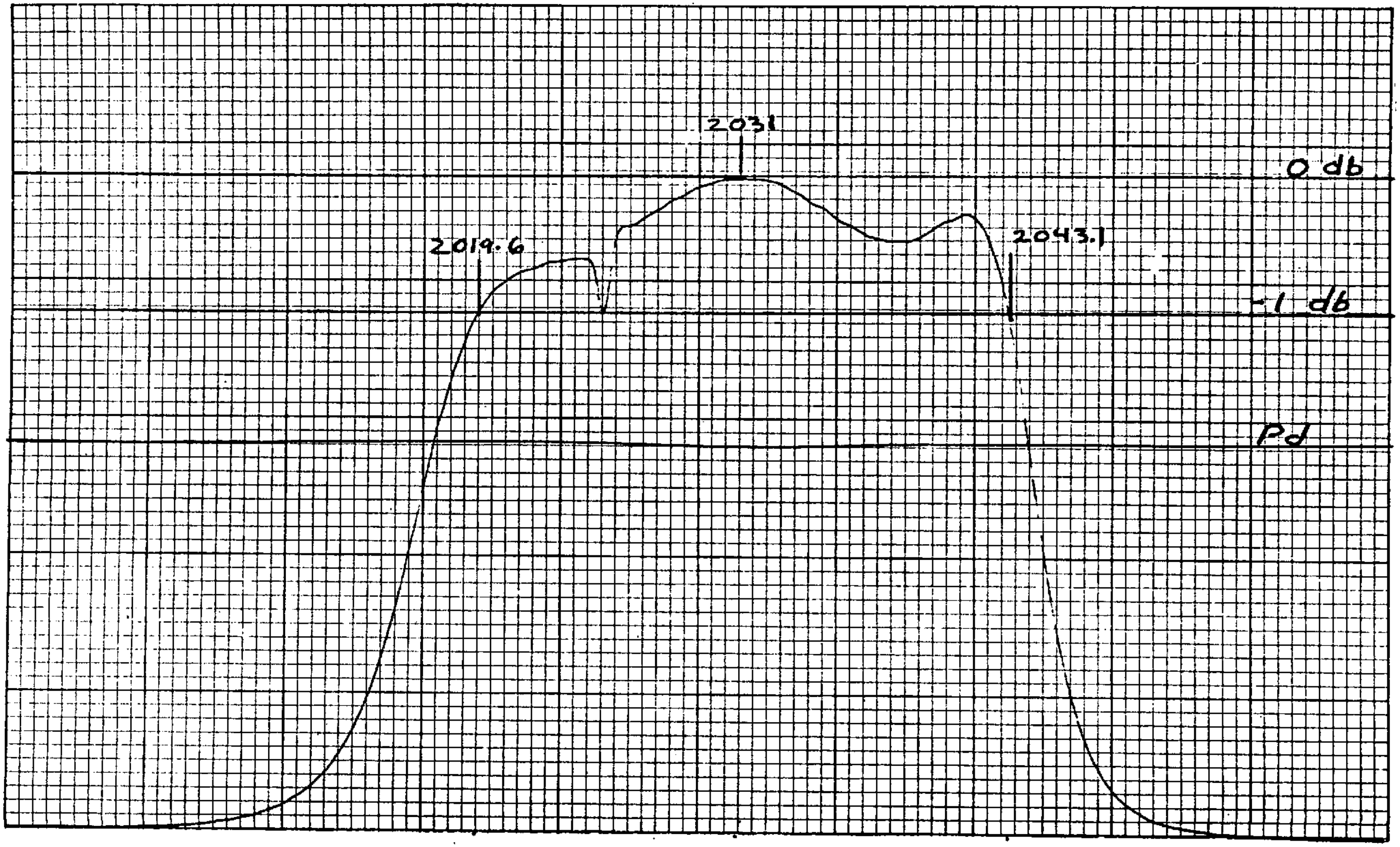


FREQUENCY, MHz

4240-10-28 8/72
TEST DATA SHEET

5K70SKW8T SERIAL NO. 1 CHANNEL 1 RETRIEVE DATE: JULY 31 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22 kV	POWER OUTPUT	25 kW
FILAMENT CURRENT	11.9 A	BEAM CURRENT	2.75 A	DRIVE POWER	440 mW
MAGNET CURRENT	17.7 A	BODY CURRENT	22 mA	GAIN	47.5 dB



FREQUENCY, MHz

5K70SK-WBT

S/N 1

KLYSTRON

CHANNEL NO. 1 1.0 kW

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2031	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.75	---	2.78	Adc
Collector Dissipation	P_{col}:	60.5	---	70	kW
Power Output	Po:	1.0	24	---	kW
Rf Input Power	Pd:	10	---	750	mW
Efficiency	E_{ff}:	1.65	39	---	%
Gain	Gain:	50.0	45	---	dB
Body Current	Iby:	10	---	75	mAdc
Bandwidth	Bw:	24.1	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.9	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	17.7	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date July 30, 1973

Varian QAR [illegible] Date [illegible] 1973

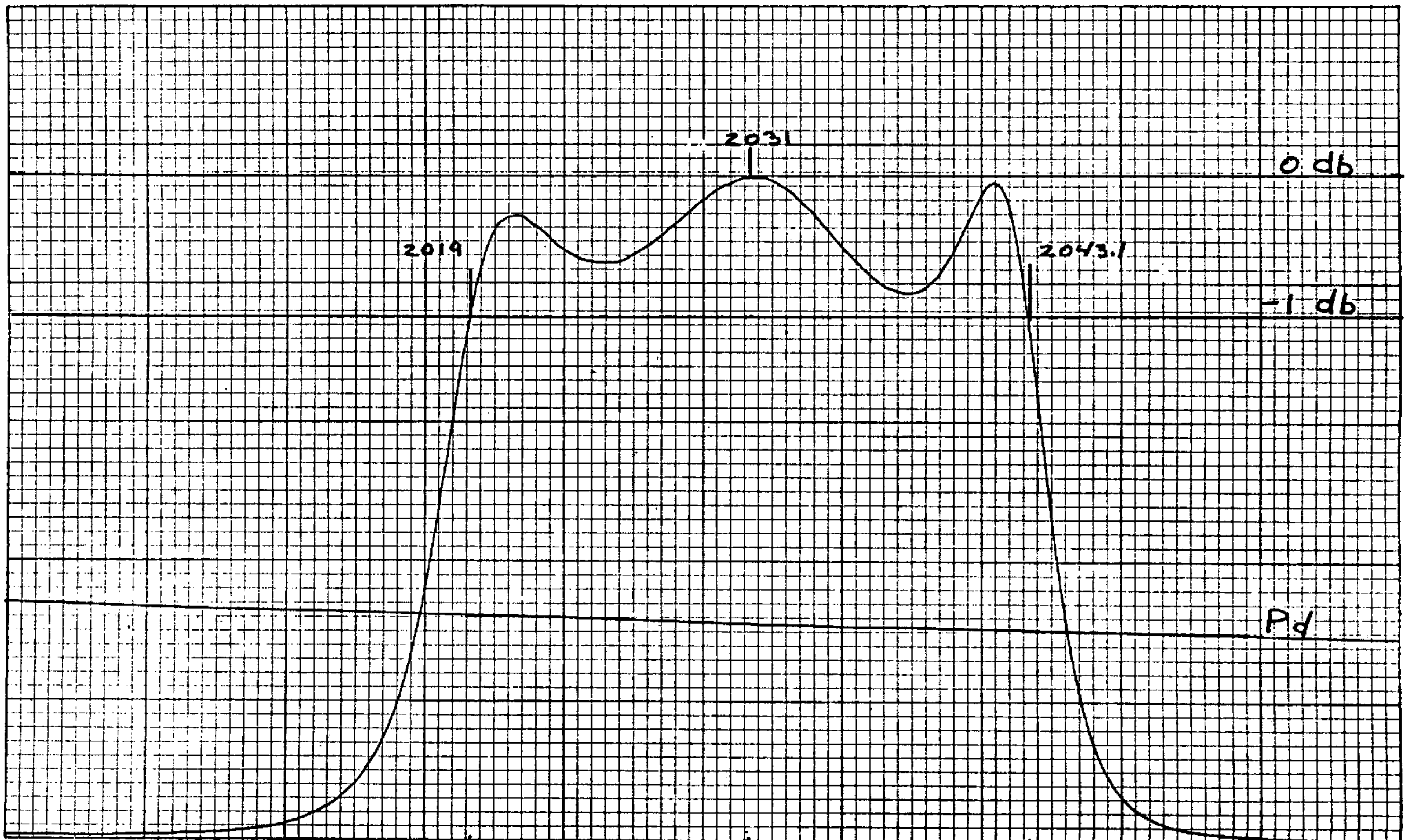
Customer QAR ______ Date ______

A	B	C	D	E
370	234	128	098	163

4240-10-25 8/72
TEST DATA SHEET

5K70SK WDT SERIAL NO. 1 | CHANNEL 1 | DATE: JULY 30 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22 kV	POWER OUTPUT	1.0 kW
FILAMENT CURRENT	11.9 A	BEAM CURRENT	2.75 A	DRIVE POWER	10 mW
MAGNET CURRENT	17.7 A	BODY CURRENT	10 mA	GAIN	50.0 dB



FREQUENCY, MHz

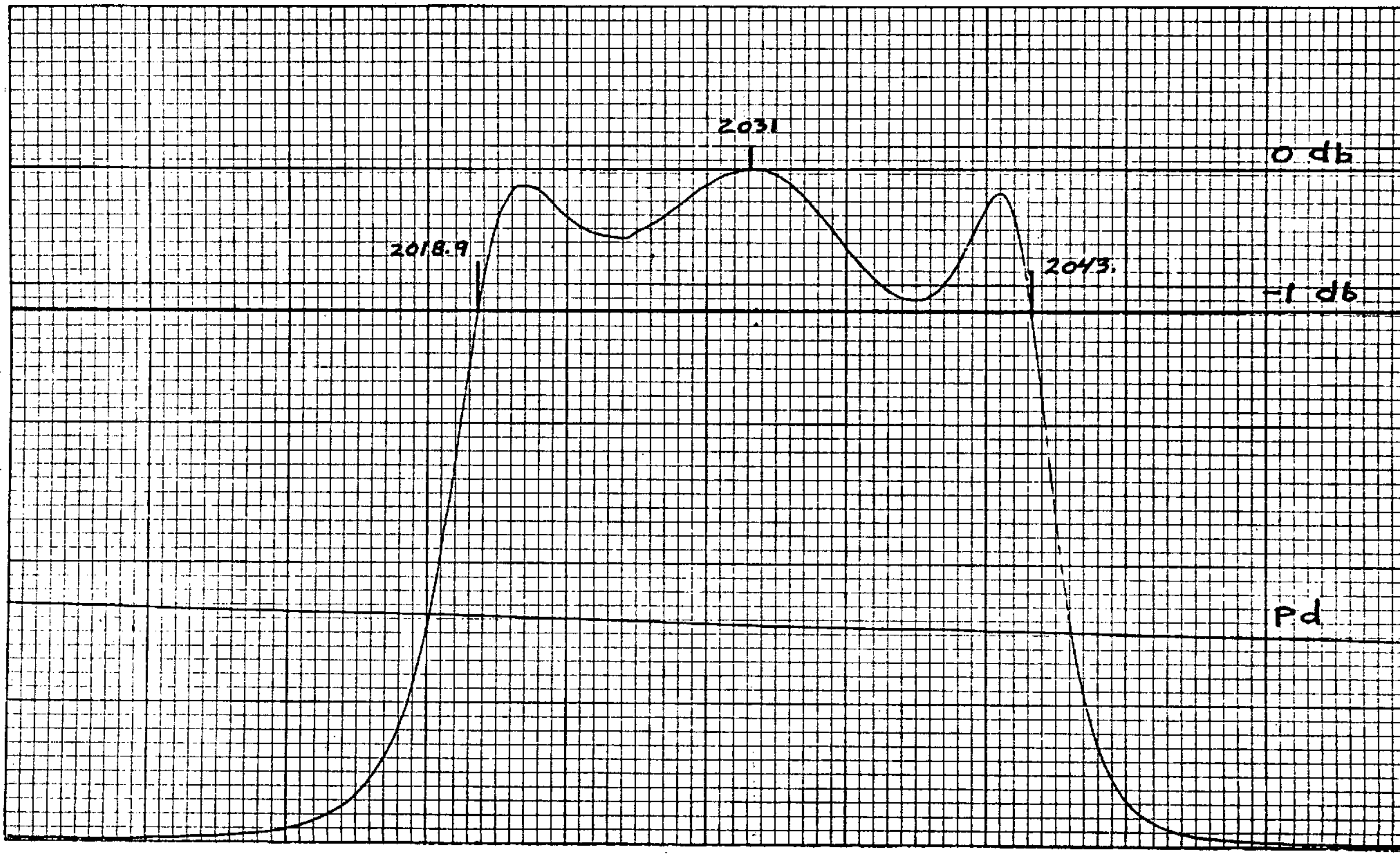
4240-10-25 8/72
TEST DATA SHEET

SK70SK WBT SERIAL NO. 1

CHANNEL L RETRIEVE

DATE: JULY 31 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22. kV	POWER OUTPUT	1.0 kW
FILAMENT CURRENT	11.9 A	BEAM CURRENT	2.75 A	DRIVE POWER	10 mW
MAGNET CURRENT	17.7 A	BODY CURRENT	10 mA	GAIN	50.0 dB



FREQUENCY, MHz

5K70SK-WBT

S/N 1

KLYSTRON

CHANNEL NO. 2 25KW

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2048	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.75	---	2.78	Adc
Collector Dissipation	P_{col}:	60.5	---	70	kW
Power Output	Po:	25.0	24	---	kW
Rf Input Power	Pd:	580	---	750	mW
Efficiency	E_{ff}:	41.4	39	---	%
Gain	Gain:	46.3	45	---	dB
Body Current	Iby:	21	---	75	mAdc
Bandwidth	Bw:	25	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.9	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	17.7	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	ΔG:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date July 30, 1973

Varian QAR [illegible] Date [illegible] 1973

Customer QAR ______ Date ______

A	B	C	D	E
447	368	265	235	310

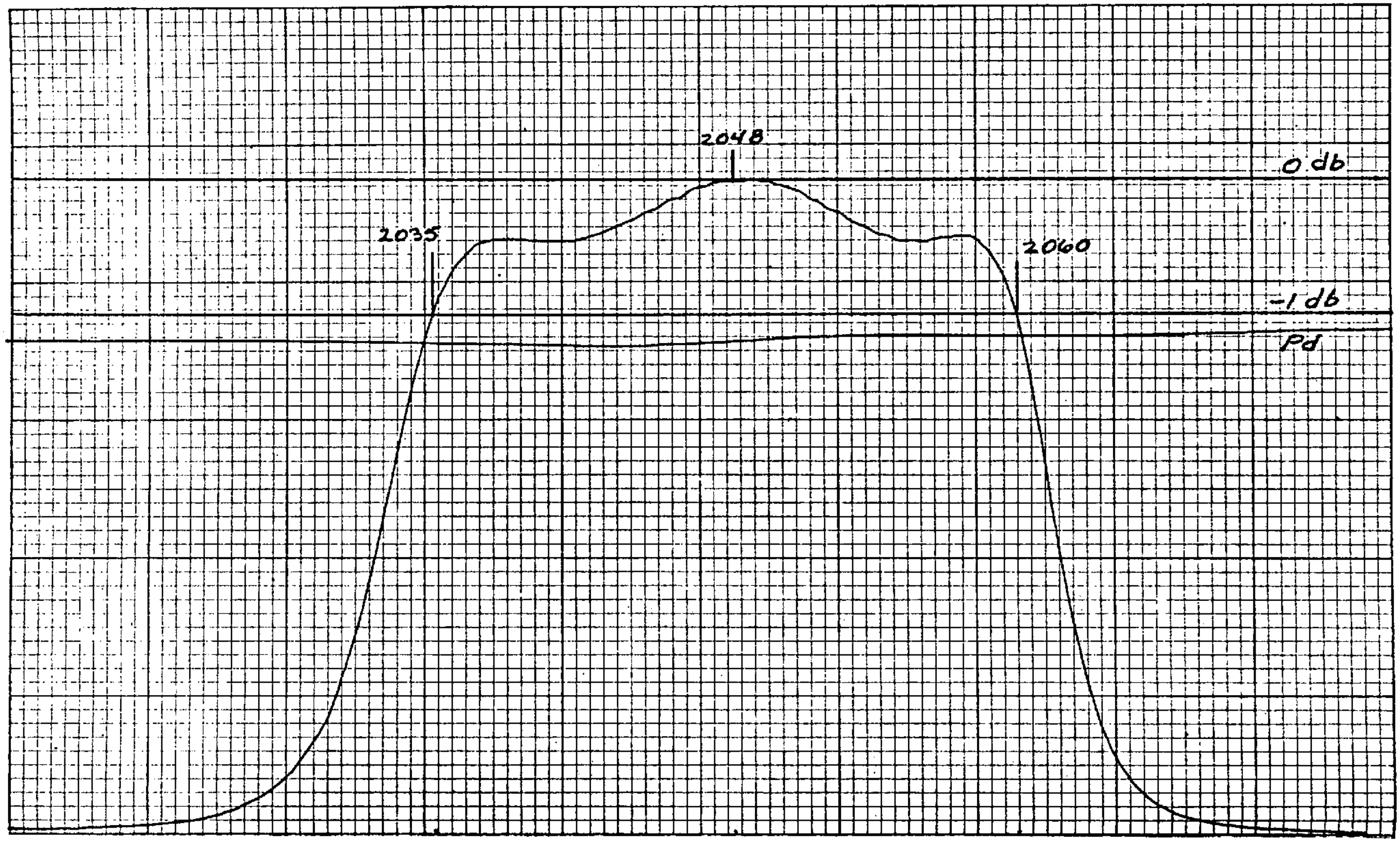
TEST DATA SHEET

5K70 SK WOT SERIAL NO. 1

CHANNEL 2

DATE: JULY 30 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V		BEAM VOLTAGE	22 kV		POWER OUTPUT	25.0 kW
FILAMENT CURRENT	11.9 A		BEAM CURRENT	2.75 A		DRIVE POWER	580 mW
MAGNET CURRENT	17.7 A		BODY CURRENT	21 mA		GAIN	46.3 dB



FREQUENCY, MHz

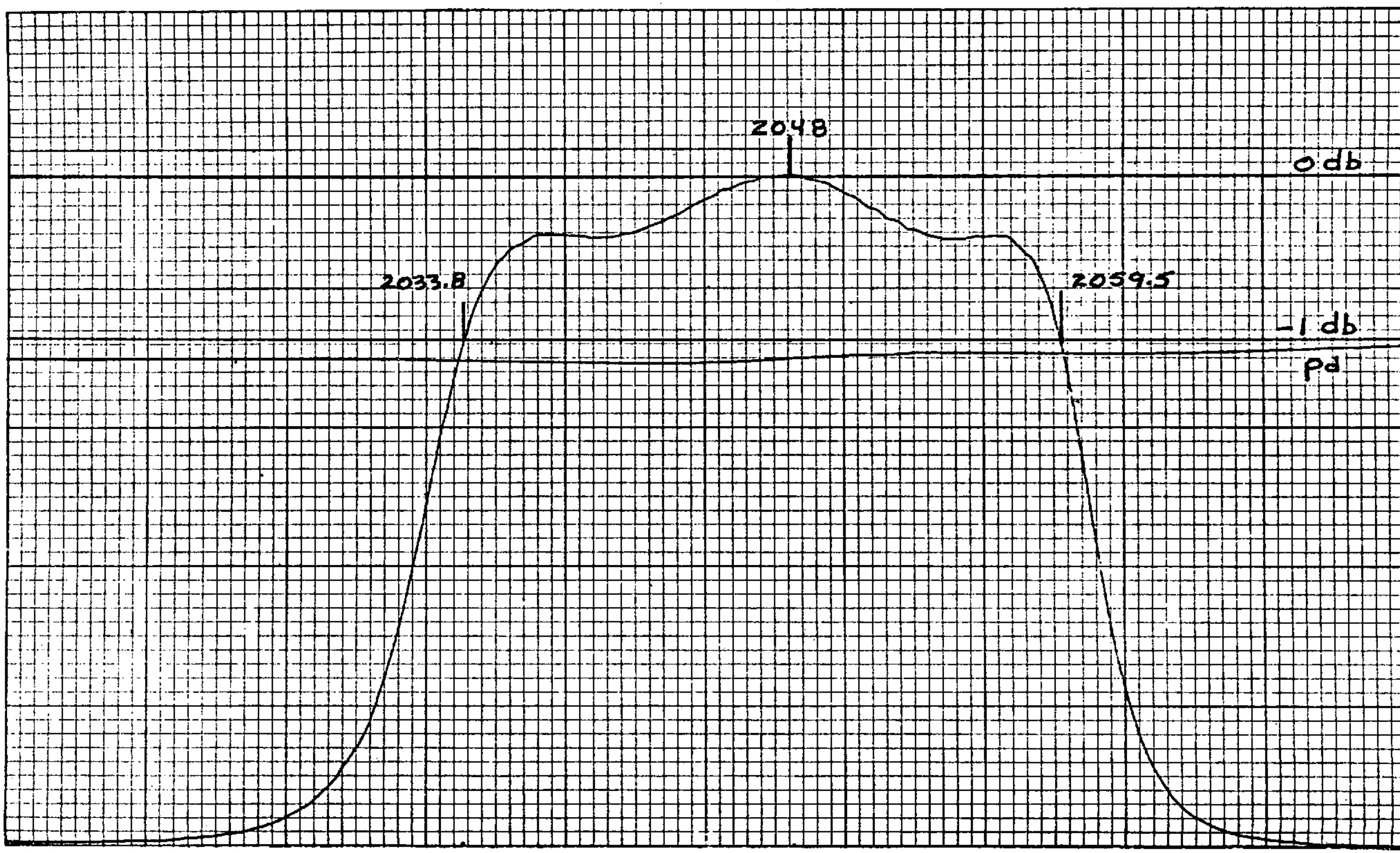
4240-10-25 8/72
TEST DATA SHEET

5K70SK WBT SERIAL NO. 1

CHANNEL 2 RETRIEVE

DATE: JULY 31 '73 BY: AAG

FILAMENT VOLTAGE 7.5 V	BEAM VOLTAGE 22 kV	POWER OUTPUT 25 kW
FILAMENT CURRENT 11.9 A	BEAM CURRENT 2.75 A	DRIVE POWER 595 mW
MAGNET CURRENT 17.7 A	BODY CURRENT 21 mA	GAIN 46.2 dB



FREQUENCY, MHz

5K70SK-WBT

S/N 1

KLYSTRON

CHANNEL NO. 2 1.0 KW

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2048	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.75	---	2.78	Adc
Collector Dissipation	P_{col}:	60.5	---	70	kW
Power Output	Po:	1.0	24	---	kW
Rf Input Power	Pd:	11.8	---	750	mW
Efficiency	E_{ff}:	1.65	39	---	%
Gain	Gain:	49.3	45	---	dB
Body Current	Iby:	10	---	75	mAdc
Bandwidth	Bw:	24.9	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.9	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	17.7	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	ΔG:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date July 30, 1973

Varian QAR [illegible] Date [illegible] 1973

Customer QAR Date

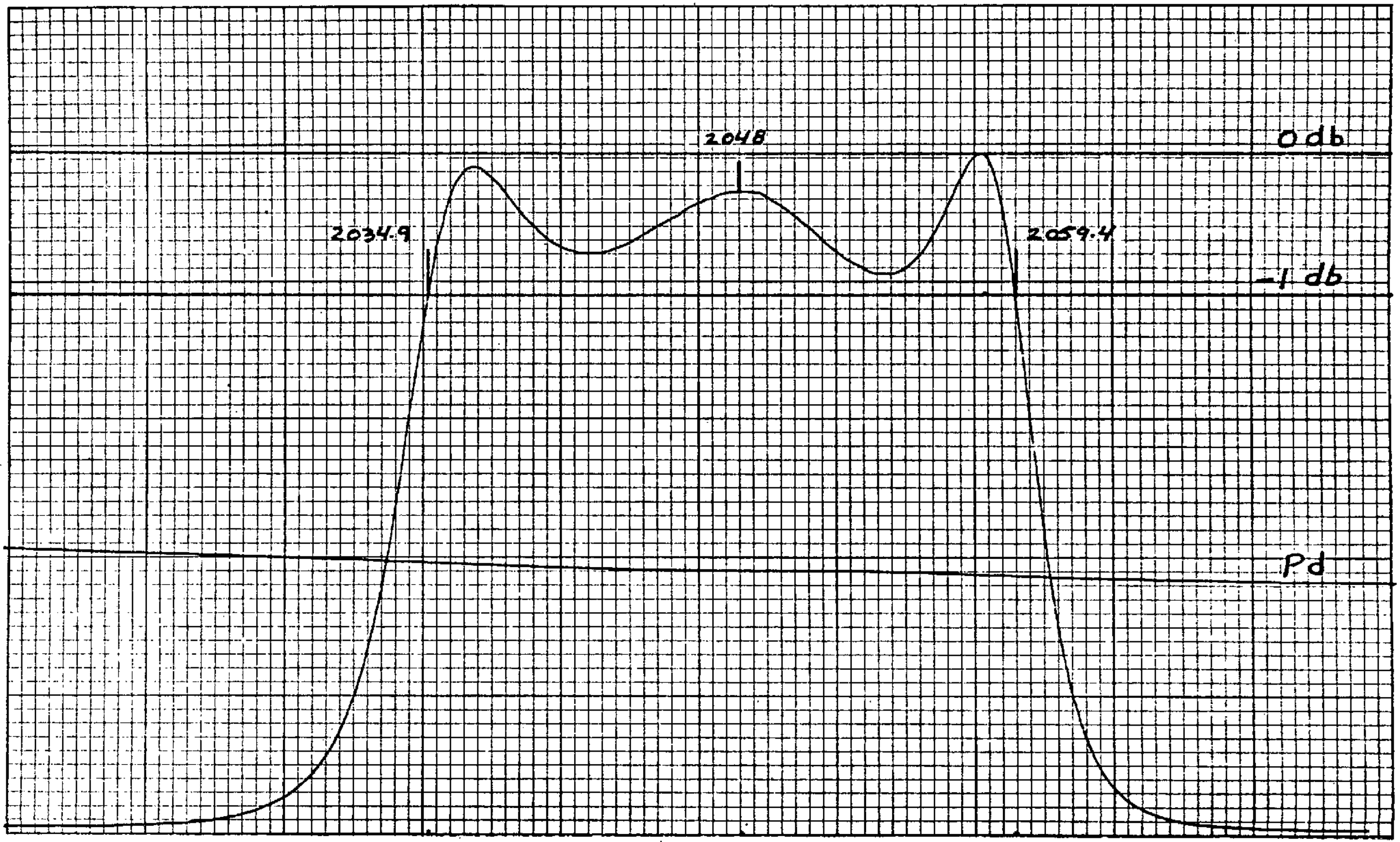
A	B	C	D	E
447	368	265	235	310
438	368	265	237 (set)	316

* 235 [illegible]

4240-10-25 8/72
TEST DATA SHEET

5K70SK WBT SERIAL NO. 1 CHANNEL 2 DATE: JULY 30'73 BY: AAG

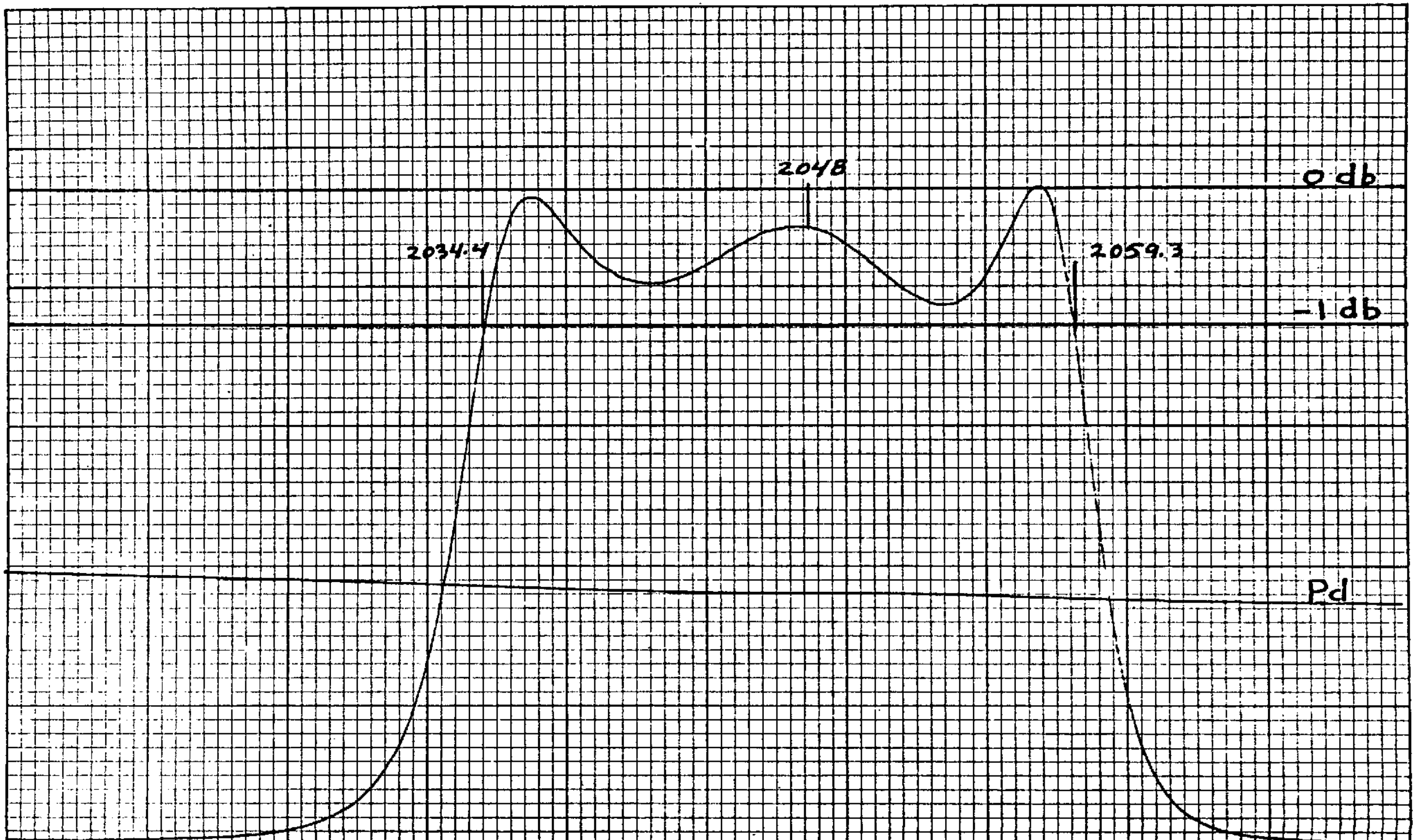
FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22 kV	POWER OUTPUT	1.0 kW
FILAMENT CURRENT	11.9 A	BEAM CURRENT	2.75 A	DRIVE POWER	11.8 mW
MAGNET CURRENT	17.7 A	BODY CURRENT	10 mA	GAIN	49.3 dB



FREQUENCY, MHz

5K70SK WBT SERIAL NO. 1 CHANNEL 2 RETRIEVE DATE: JULY 31 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22 kV	POWER OUTPUT	1.0 kW
FILAMENT CURRENT	11.9 A	BEAM CURRENT	2.75 A	DRIVE POWER	11.9 mW
MAGNET CURRENT	17.7 A	BODY CURRENT	10 mA	GAIN	49.2 dB



FREQUENCY, MHz

5K70SK-WBT

S/N 1

KLYSTRON

CHANNEL NO. 3 25.0 KW

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2065	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.75	---	2.78	Adc
Collector Dissipation	P_{col}:	60.5	---	70	kW
Power Output	Po:	25.0	24	---	kW
Rf Input Power	Pd:	440	---	750	mW
Efficiency	E_{ff}:	41.4	39	---	%
Gain	Gain:	47.5	45	---	dB
Body Current	Iby:	22.0	---	75	mAdc
Bandwidth	Bw:	23.8	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.9	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	17.7	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF	< 35	---	35	dB

Tested By: Art Goldfinger Date July 30, 1973

Varian QAR [illegible] Date [illegible]

Customer QAR ______ Date ______

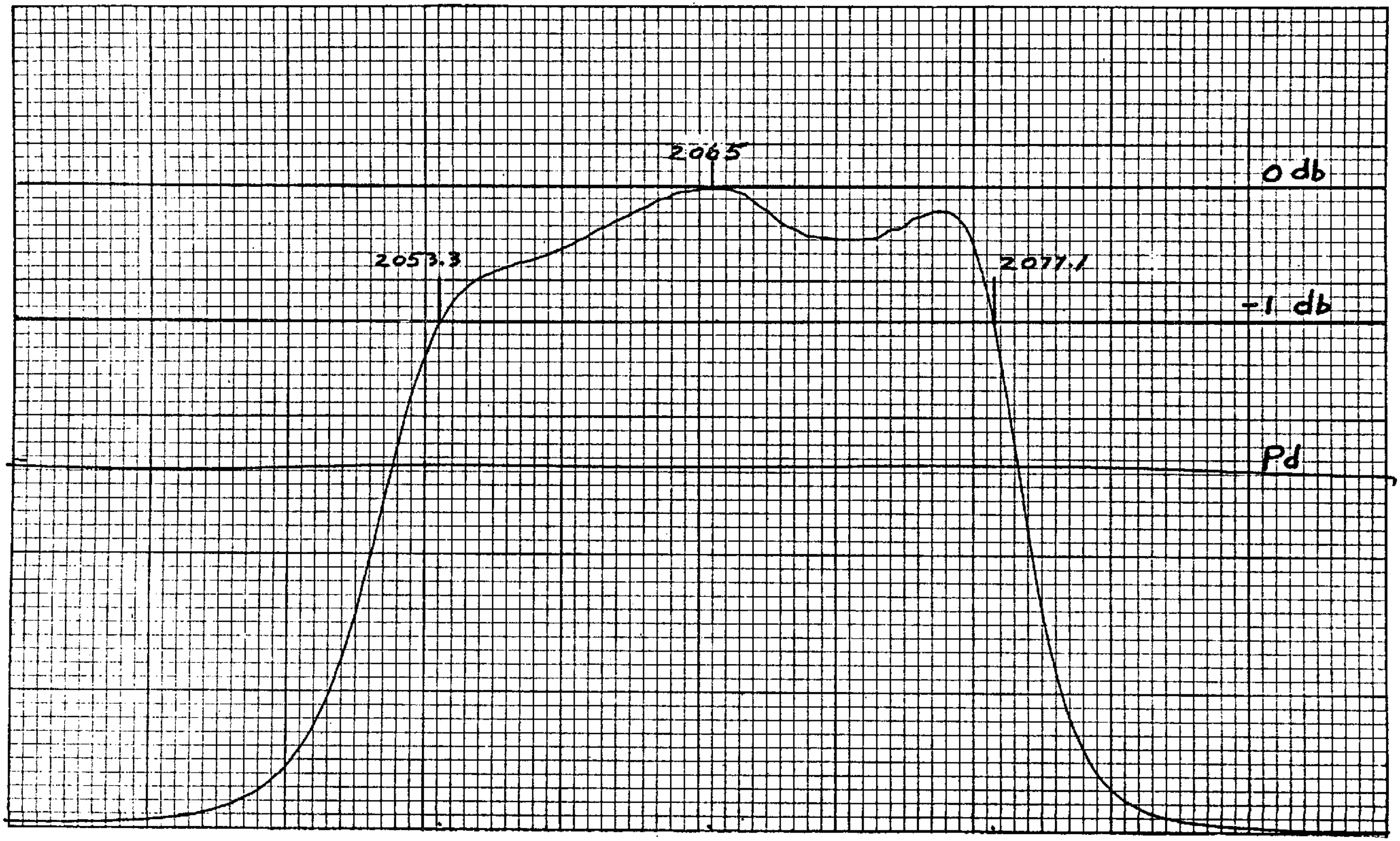
A	B	C	D	E
544	494	387	371	430

5K70SK WBT SERIAL NO. 1   CHANNEL 3   DATE: JULY 30'73 BY: AAG

FILAMENT VOLTAGE 7.5 V
FILAMENT CURRENT 11.9 A
MAGNET CURRENT 17.7 A

BEAM VOLTAGE 22 kV
BEAM CURRENT 2.75 A
BODY CURRENT 22 mA

POWER OUTPUT 25.0 kW
DRIVE POWER 440 mW
GAIN 47.5 dB



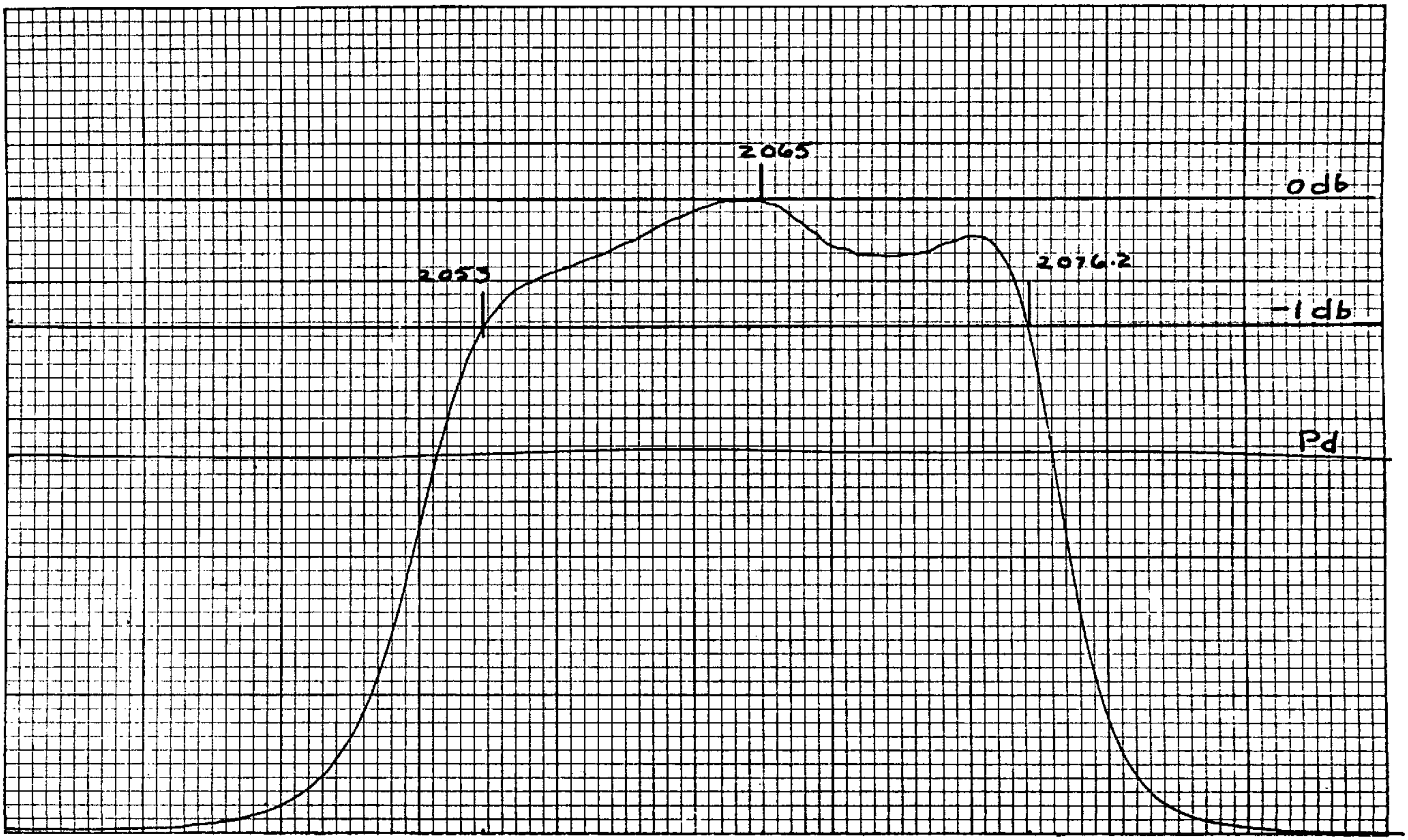
FREQUENCY, MHz

5K70SK WBT SERIAL NO. 1 CHANNEL 3 RETRIEVE DATE: JULY 31 '73 BY: AAG

FILAMENT VOLTAGE 7.5 V
FILAMENT CURRENT 11.9 A
MAGNET CURRENT 17.7 A

BEAM VOLTAGE 22 kV
BEAM CURRENT 2.75 A
BODY CURRENT 22 mA

POWER OUTPUT 25.0 kW
DRIVE POWER 490 mW
GAIN 47.0 dB



FREQUENCY, MHz

5K70SK-WBT

S/N 1

KLYSTRON

CHANNEL NO. 3 1.0 KW

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2065	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.75	---	2.78	Adc
Collector Dissipation	P_{col}:	60.5	---	70	kW
Power Output	Po:	1.00	24	---	kW
Rf Input Power	Pd:	7.0	---	750	mW
Efficiency	E_{ff}:	1.65	39	---	%
Gain	Gain:	51.5	45	---	dB
Body Current	Iby:	10	---	75	mAdc
Bandwidth	Bw:	23.6	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.9	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	17.7	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF	< 35	---	35	dB

Tested By: Art Goldfinger Date July 30, 1973

Varian QAR [illegible] Date [illegible] 1973

Customer QAR ____ ____ Date ____

A	B	C	D	E
544	494	387	371	430

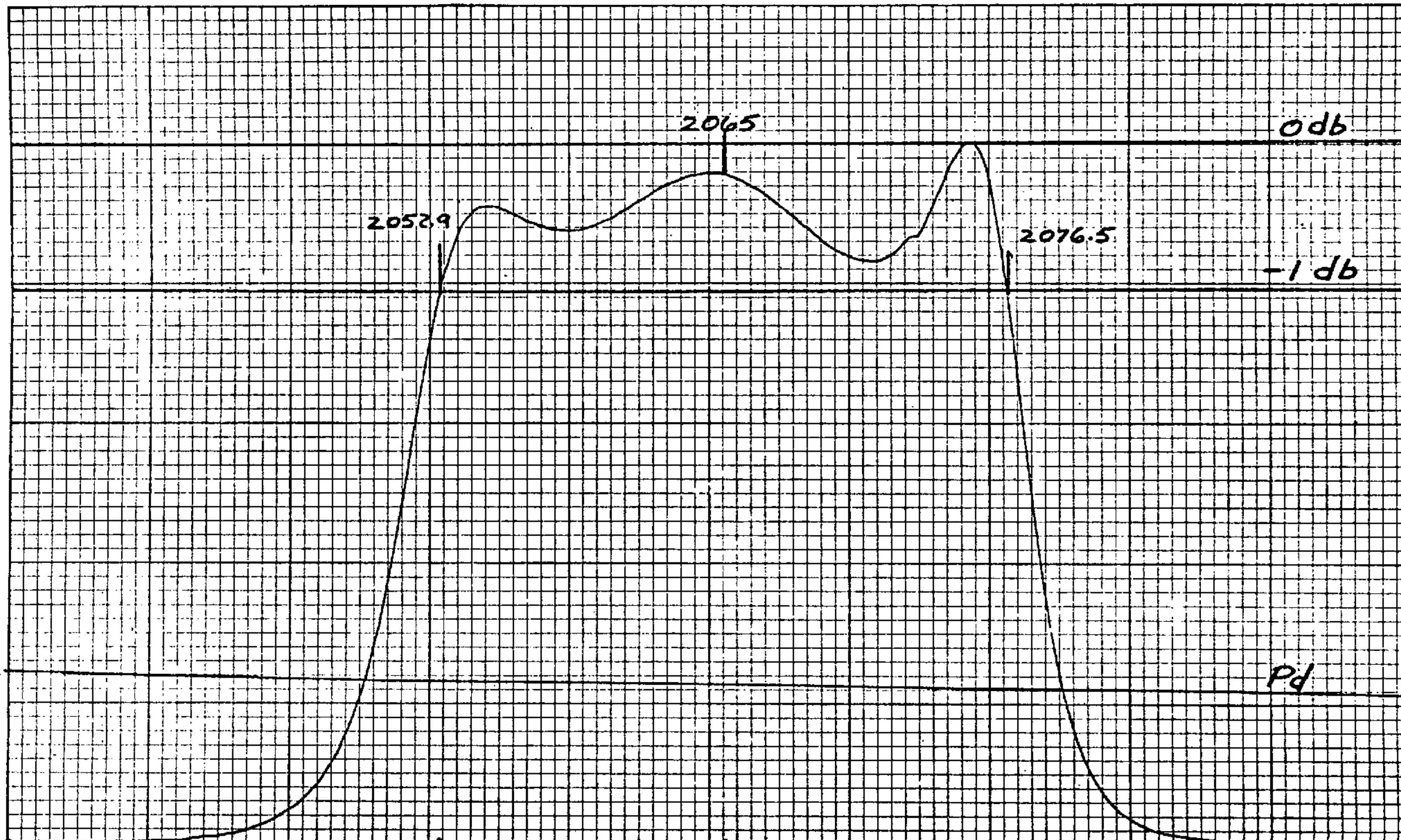
TEST DATA SHEET

5K70SK WBT SERIAL NO. 1 CHANNEL 3 DATE: JULY 30 '73 BY: AAG

FILAMENT VOLTAGE 7.5 V
FILAMENT CURRENT 11.9 A
MAGNET CURRENT 17.7 A

BEAM VOLTAGE 22 kV
BEAM CURRENT 2.75 A
BODY CURRENT 10 mA

POWER OUTPUT 1.0 kW
DRIVE POWER 7.0 mW
GAIN 51.5 dB



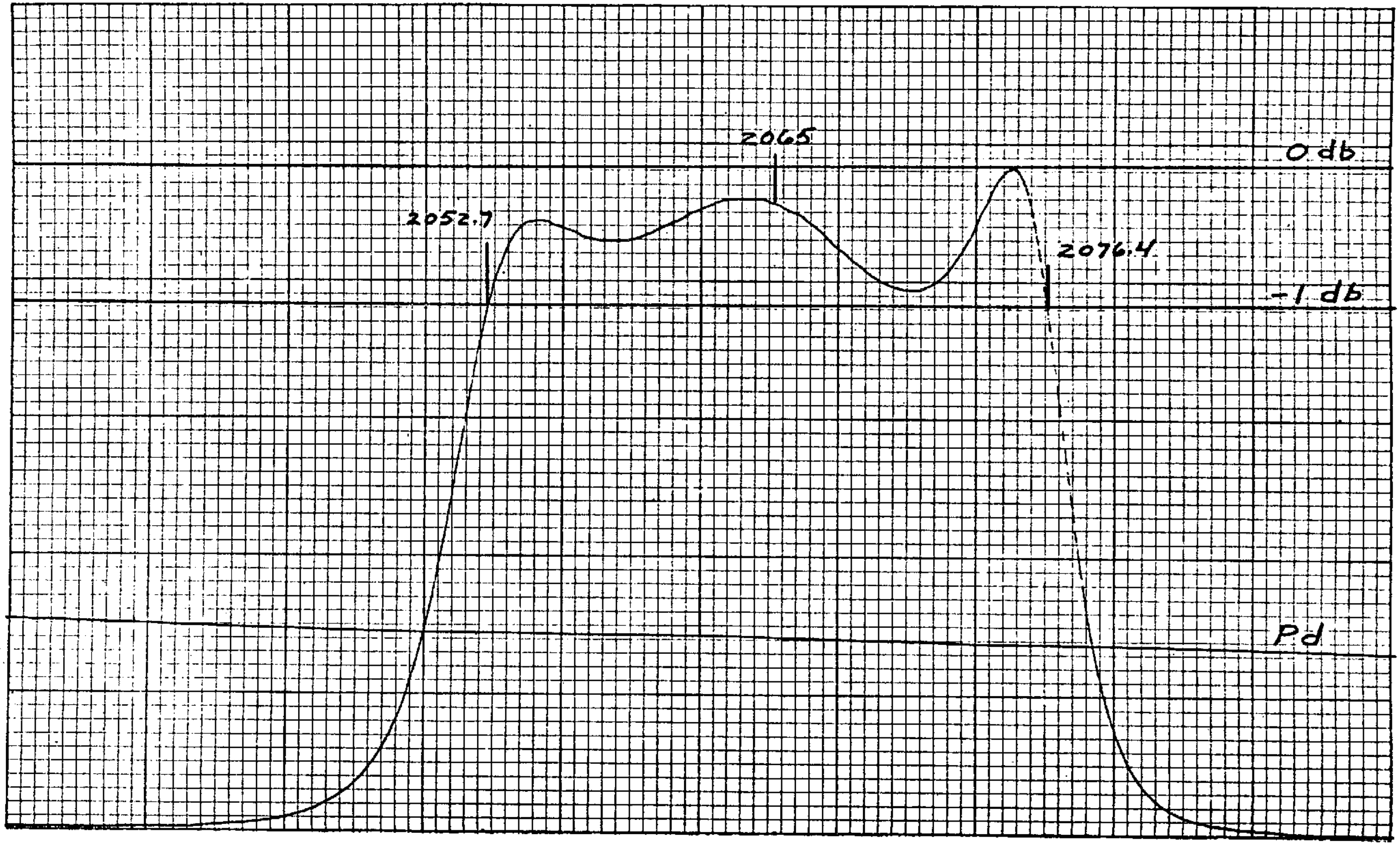
FREQUENCY, MHz

SK705K WBT SERIAL NO. 1

CHANNEL 3 RETRIEVE

DATE: JULY 31 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V		BEAM VOLTAGE	22 kV		POWER OUTPUT	1.0 kW
FILAMENT CURRENT	11.9 A		BEAM CURRENT	2.75 A		DRIVE POWER	9.2 mW
MAGNET CURRENT	17.7 A		BODY CURRENT	10 mA		GAIN	50.3 dB



FREQUENCY, MHz

5K70SK-WBT

S/N 1

KLYSTRON

CHANNEL NO. 4 25KW

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2082	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.75	---	2.78	Adc
Collector Dissipation	P_{col}:	60.5	---	70	kW
Power Output	Po:	25.0	24	---	kW
Rf Input Power	Pd:	580	---	750	mW
Efficiency	E_{ff}:	41.4	39	---	%
Gain	Gain:	46.3	45	---	dB
Body Current	Iby:	24.0	---	75	mAdc
Bandwidth	Bw:	24.4	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.9	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	17.7	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	ΔG:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date July 30, 1973

Varian QAR [illegible] Date [illegible]

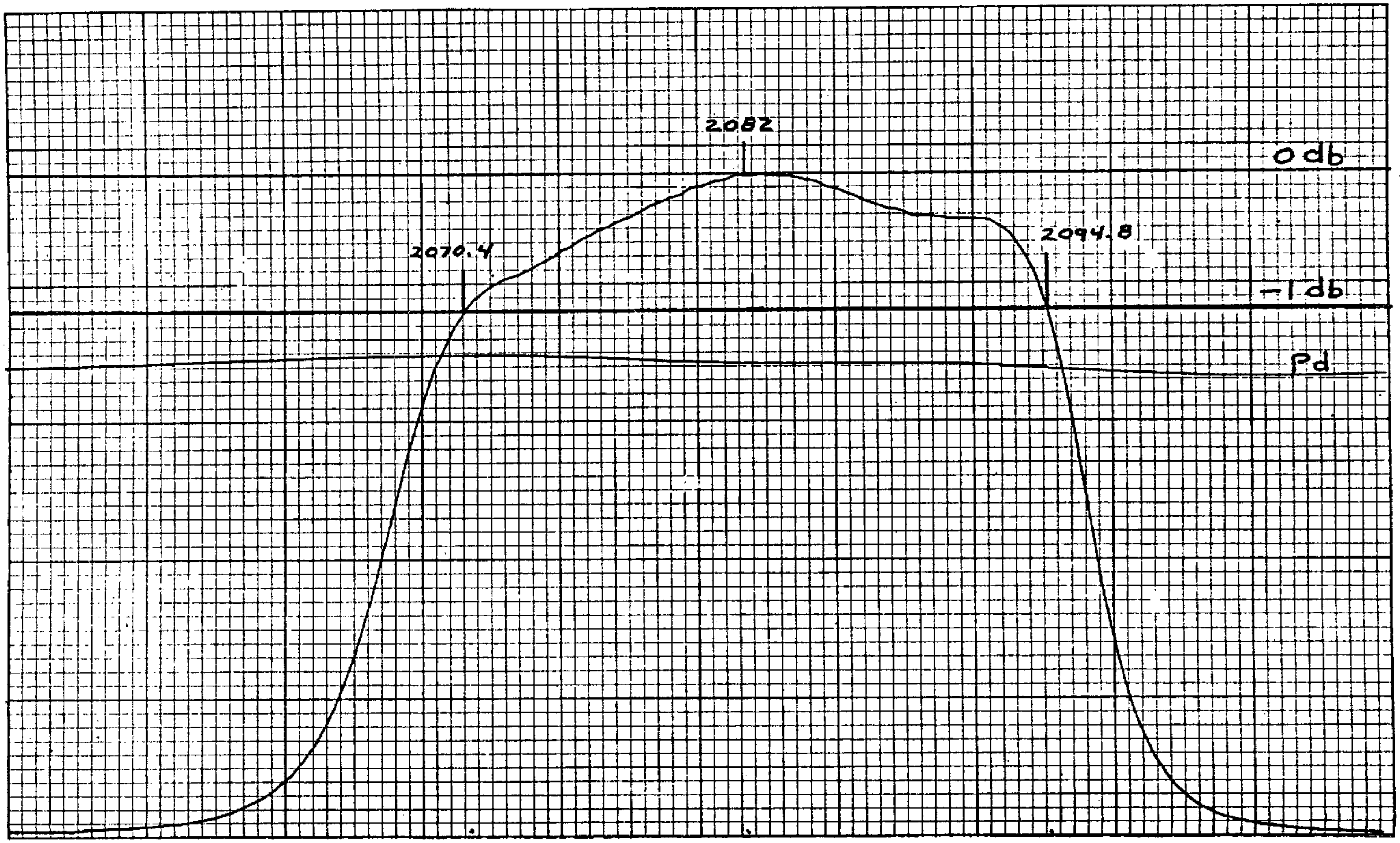
Customer QAR ______________ Date ______________

A	B	C	D	E
621	591	502	483	543

TEST DATA SHEET

5K70SK WBT SERIAL NO. 1 CHANNEL 4 DATE: JULY 30' 73 BY: AAG

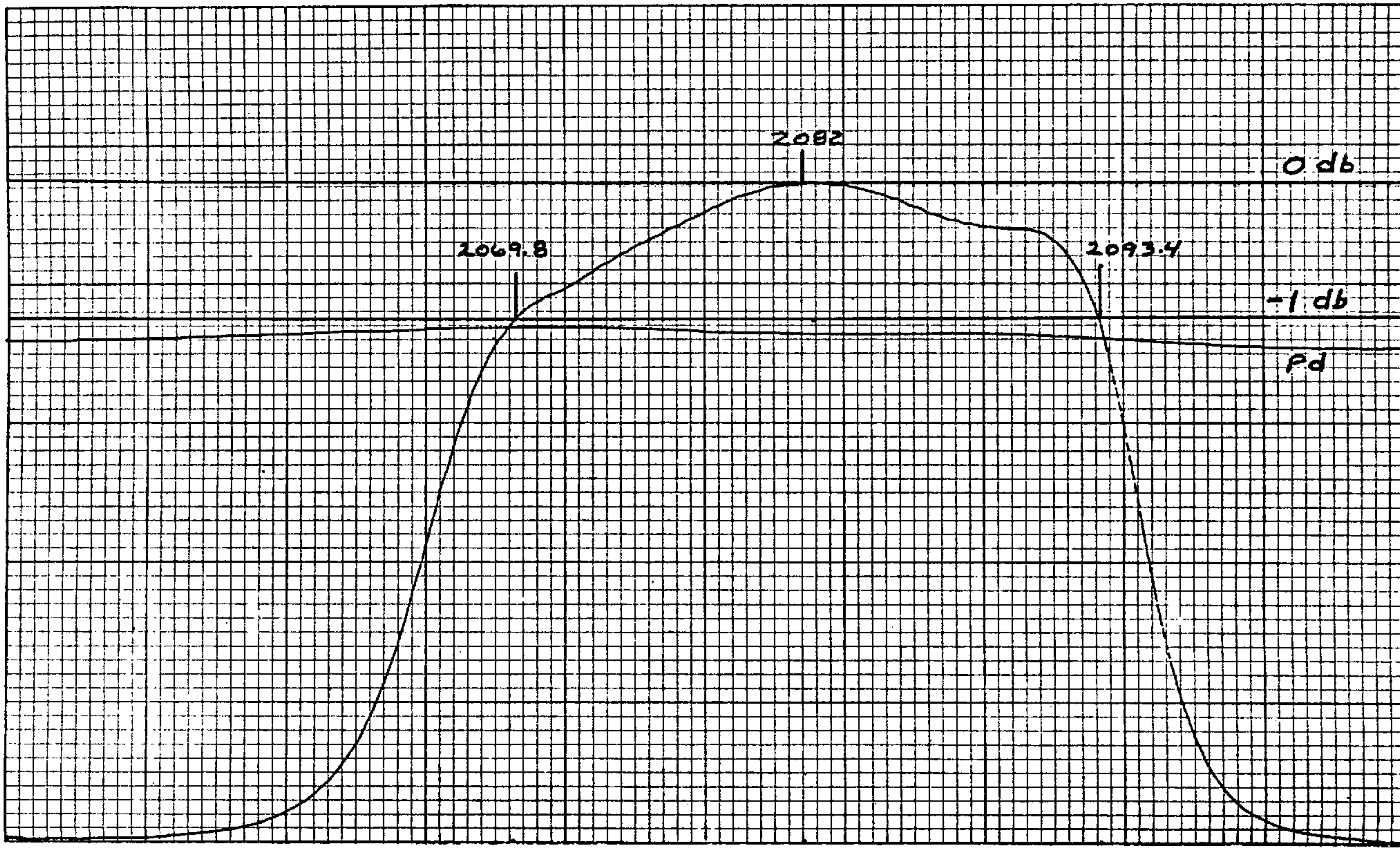
FILAMENT VOLTAGE	7.5	V	BEAM VOLTAGE	22	kV	POWER OUTPUT	25.0	kW
FILAMENT CURRENT	11.9	A	BEAM CURRENT	2.75	A	DRIVE POWER	580	mW
MAGNET CURRENT	17.7	A	BODY CURRENT	24	mA	GAIN	46.3	dB



FREQUENCY, MHz

5K70SK WBT SERIAL NO. 1   CHANNEL 4 RETRIEVE   DATE: JULY 31 '73 BY: AAG

FILAMENT VOLTAGE	7.5	V	BEAM VOLTAGE	22 kV	POWER OUTPUT	25.0	kW
FILAMENT CURRENT	11.9	A	BEAM CURRENT	2.75 A	DRIVE POWER	605	mW
MAGNET CURRENT	17.7	A	BODY CURRENT	23 mA	GAIN	46.1	dB



FREQUENCY, MHz

5K70SK-WBT

S/N 1

KLYSTRON

CHANNEL NO. 4 1.0 KW

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2082	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.75	---	2.78	Adc
Collector Dissipation	P_{col}:	60.5	---	70	kW
Power Output	Po:	1.0	24	---	kW
Rf Input Power	Pd:	10.5	---	750	mW
Efficiency	E_{ff}:	1.65	39	---	%
Gain	Gain:	49.8	45	---	dB
Body Current	Iby:	10.5	---	75	mAdc
Bandwidth	Bw:	24.8	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.9	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	17.7	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	ΔG:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date July 30, 1973

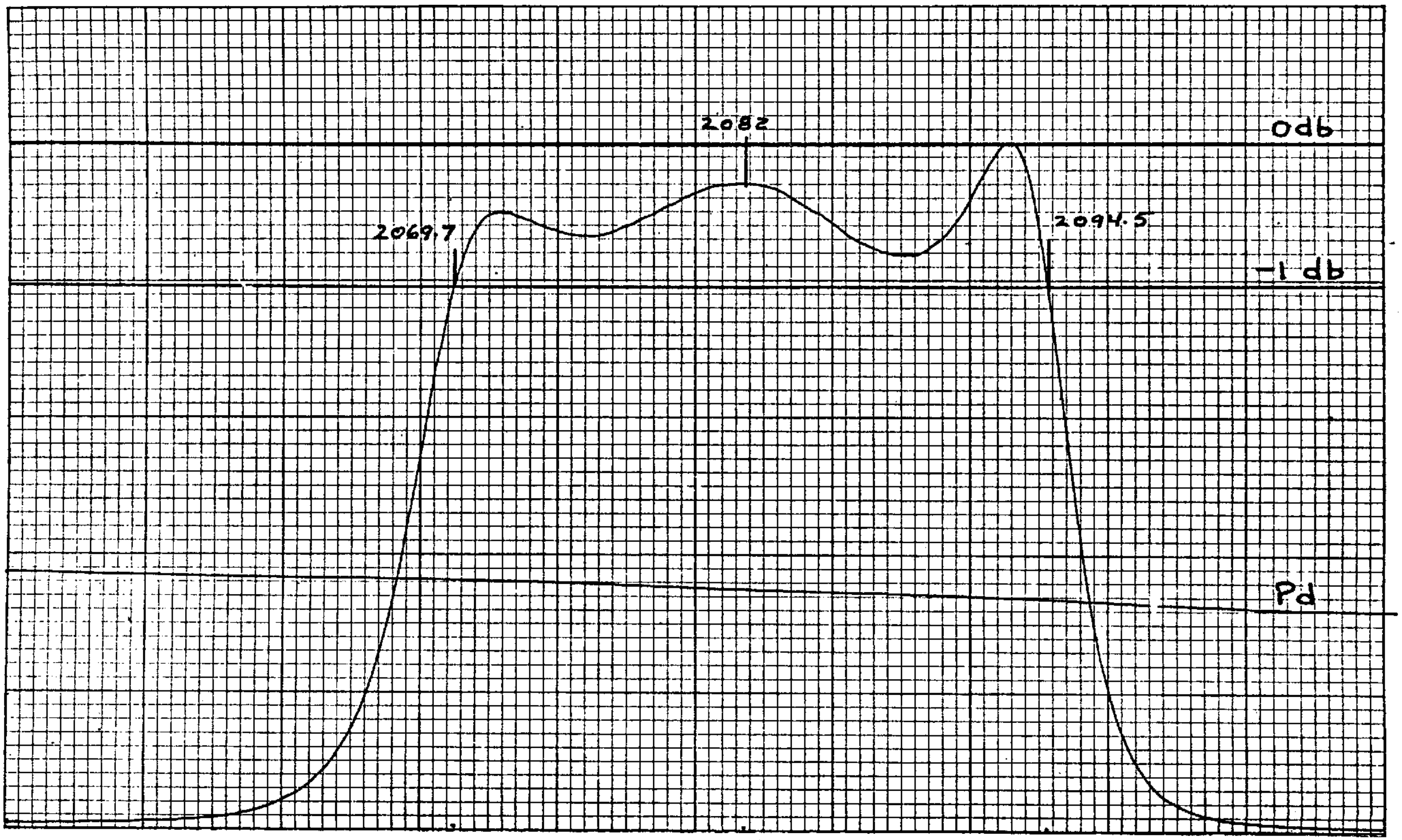
Varian QAR [illegible] Date [illegible] 1973

Customer QAR ______ Date ______

A	B	C	D	E
621	591	502	483	543

5K705K WBT SERIAL NO. 1 — CHANNEL 4 — DATE: JULY 30 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22 kV	POWER OUTPUT	1.0 kW
FILAMENT CURRENT	11.9 A	BEAM CURRENT	2.75 A	DRIVE POWER	10.5 mW
MAGNET CURRENT	17.7 A	BODY CURRENT	10.5 mA	GAIN	49.8 dB



FREQUENCY, MHz

4240-10-25 8/72
TEST DATA SHEET

5K70SK WBT SERIAL NO. 1

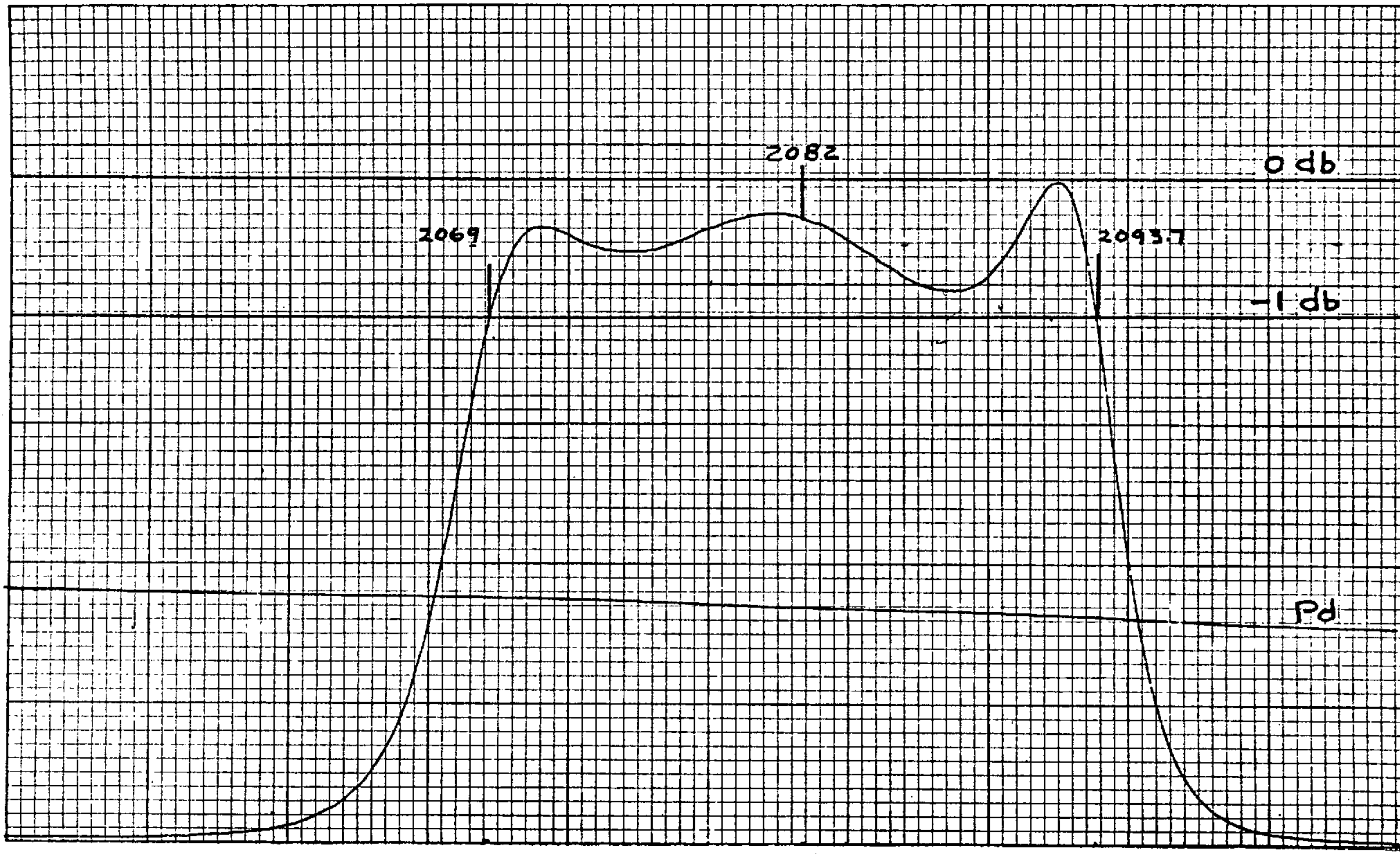
CHANNEL 4 RETRIEVE

DATE: JULY 31 '73 BY: AAG

FILAMENT VOLTAGE 7.5 V
FILAMENT CURRENT 11.9 A
MAGNET CURRENT 17.7 A

BEAM VOLTAGE 22 kV
BEAM CURRENT 2.75 A
BODY CURRENT 10 mA

POWER OUTPUT 1.0 kW
DRIVE POWER 11.0 mW
GAIN 49.6 dB



FREQUENCY, MHz

S/N 1

KLYSTRON

CHANNEL NO. 5 25 KW

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2099	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.75	---	2.78	Adc
Collector Dissipation	P_{col}:	60.5	---	70	kW
Power Output	Po:	25.0	24	---	kW
Rf Input Power	Pd:	655	---	750	mW
Efficiency	E_{ff}:	41.4	39	---	%
Gain	Gain:	46.8	45	---	dB
Body Current	Iby:	22.0	---	75	mAdc
Bandwidth	Bw:	25.6	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.9	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	17.7	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date July 30, 1973

Varian QAR [illegible] Date [illegible] 1973

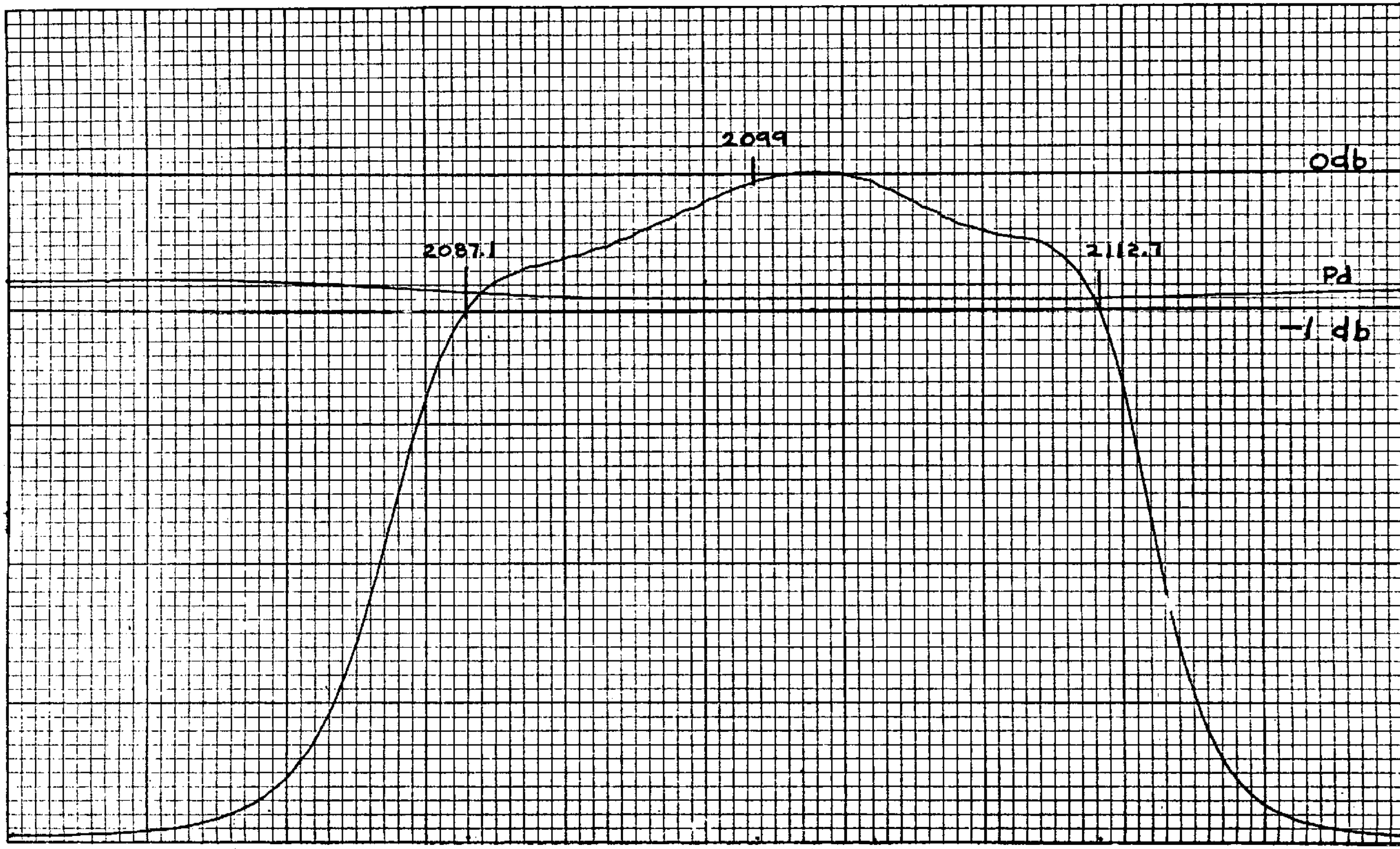
Customer QAR ______ Date ______

A	B	C	D	E
693	638	608	585	648

TEST DATA SHEET

5K70SK WBT SERIAL NO. 1 CHANNEL 5 DATE: JULY 30 '73 BY: AAG

FILAMENT VOLTAGE	7.5	V	BEAM VOLTAGE	22	kV	POWER OUTPUT	25	kW
FILAMENT CURRENT	11.9	A	BEAM CURRENT	2.75	A	DRIVE POWER	655	mW
MAGNET CURRENT	17.7	A	BODY CURRENT	22	mA	GAIN	45.8	dB



FREQUENCY, MHz

TEST DATA SHEET

5K70SK WBT SERIAL NO. 1

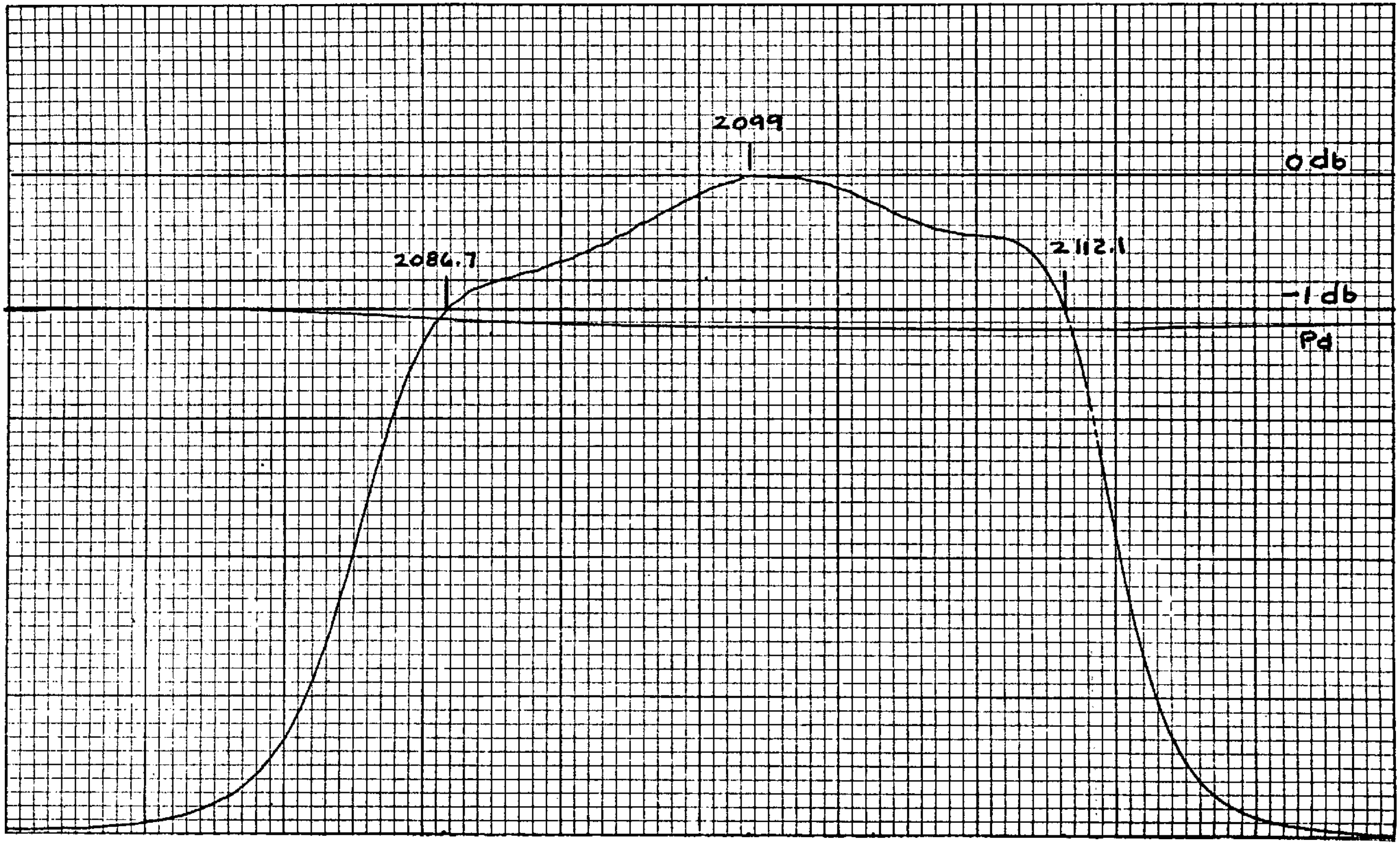
CHANNEL 5 RETRIEVE

DATE: JULY 31 '73 BY: AAG

FILAMENT VOLTAGE 7.5 V
FILAMENT CURRENT 11.9 A
MAGNET CURRENT 17.7 A

BEAM VOLTAGE 22 kV
BEAM CURRENT 2.75 A
BODY CURRENT 21 mA

POWER OUTPUT 25 kW
DRIVE POWER 590 mW
GAIN 46.2 dB



FREQUENCY, MHz

5K70SK-WBT

S/N 1

KLYSTRON

CHANNEL NO. 5 1.0KW

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2099	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.75	---	2.78	Adc
Collector Dissipation	P_{col}:	60.5	---	70	kW
Power Output	Po:	1.0	24	---	kW
Rf Input Power	Pd:	12.5	---	750	mW
Efficiency	E_{ff}:	1.65	39	---	%
Gain	Gain:	49.0	45	---	dB
Body Current	Iby:	11.0	---	75	mAdc
Bandwidth	Bw:	25.8	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.9	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	17.7	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< ±0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date July 30, 1973

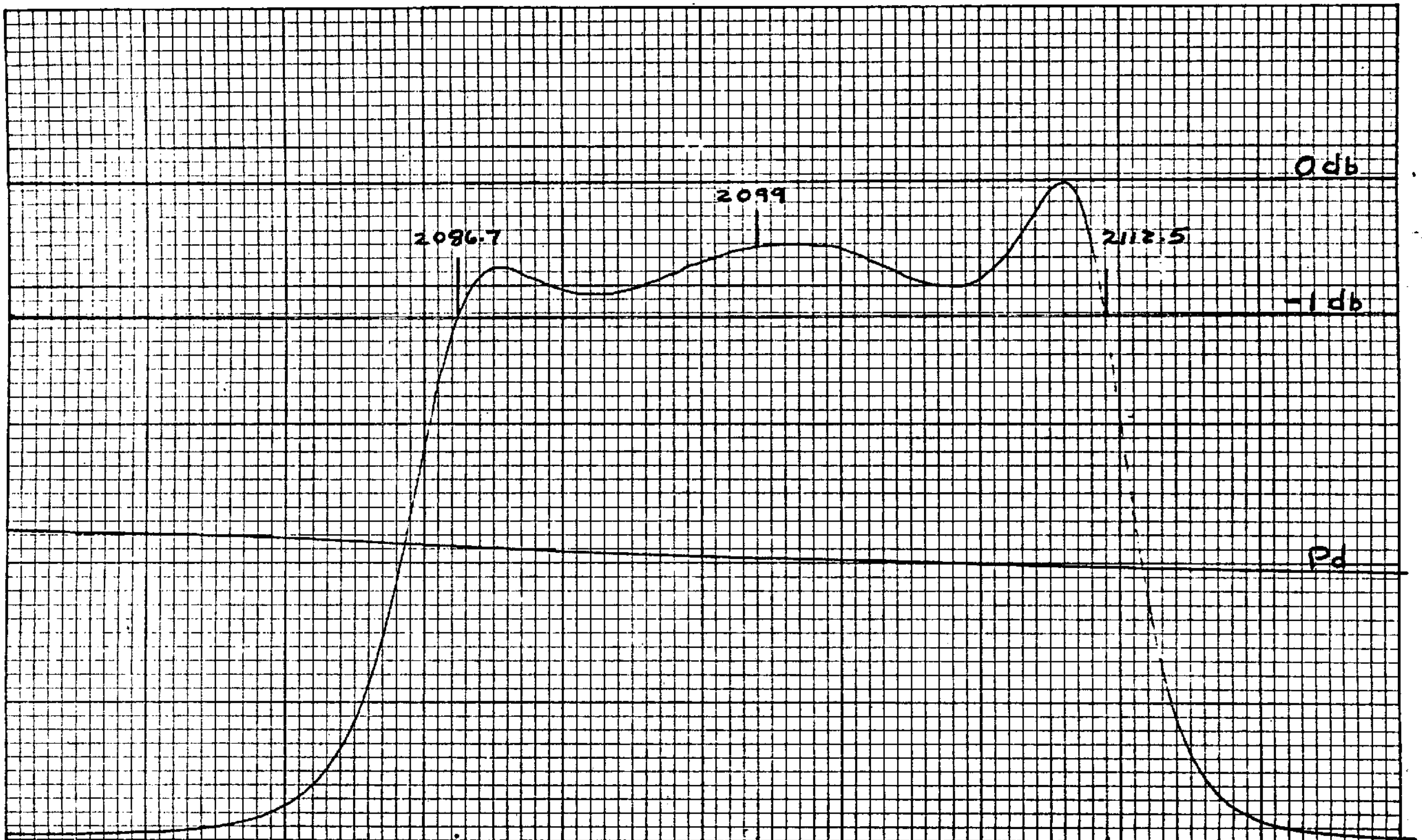
Varian QAR [illegible] Date [illegible] 1, 1973

Customer QAR Date

A	B	C	D	E
693	638	608	585	648

5K70SK WBT SERIAL NO. 1 CHANNEL 5 DATE: JULY 30 '73 BY: AAG

FILAMENT VOLTAGE 7.5 V	BEAM VOLTAGE 22 kV	POWER OUTPUT 1.0 kW
FILAMENT CURRENT 11.9 A	BEAM CURRENT 2.75 A	DRIVE POWER 12.5 mW
MAGNET CURRENT 17.7 A	BODY CURRENT 11.0 mA	GAIN 49.0 dB



FREQUENCY, MHz

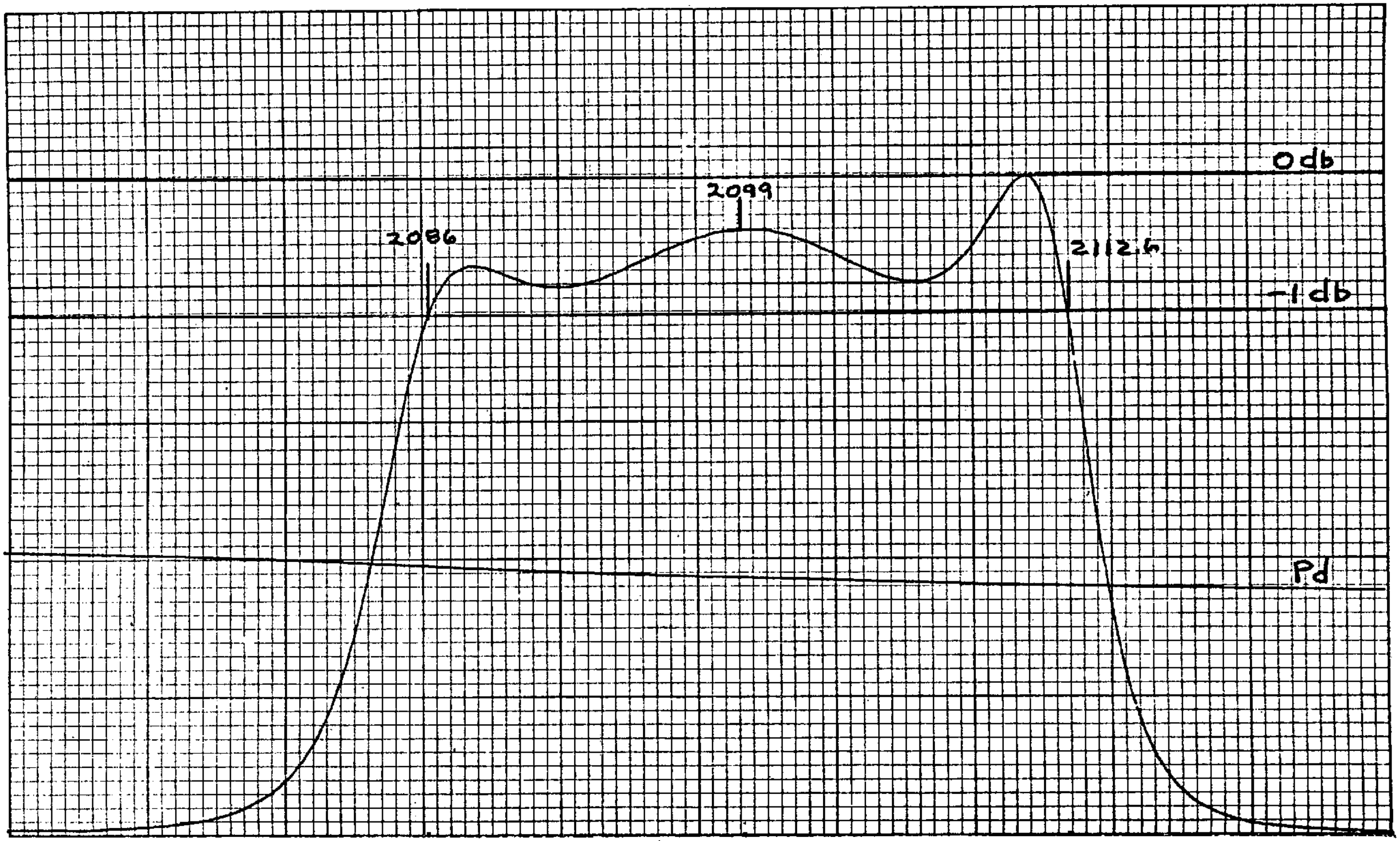
TEST DATA SHEET

5K705K WBT SERIAL NO. 1

CHANNEL 5 RETRIEVE

DATE: JULY 31 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22 kV	POWER OUTPUT	1.0 kW
FILAMENT CURRENT	11.9 A	BEAM CURRENT	2.75 A	DRIVE POWER	11.7 mW
MAGNET CURRENT	17.7 A	BODY CURRENT	11.0 mA	GAIN	49.4 dB



FREQUENCY, MHz

5K70SK-WBT

S/N 1

KLYSTRON

CHANNEL NO. 6 25 KW

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2116	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.75	---	2.78	Adc
Collector Dissipation	P_{col}:	60.5	---	70	kW
Power Output	Po:	26.0	24	---	kW
Rf Input Power	Pd:	615	---	750	mW
Efficiency	E_{ff}:	41.4	39	---	%
Gain	Gain:	46.1	45	---	dB
Body Current	Iby:	23.0	---	75	mAdc
Bandwidth	Bw:	23.6	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.9	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	17.7	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	ΔG:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date July 30, 1973

Varian QAR [illegible] Date [illegible] 1973

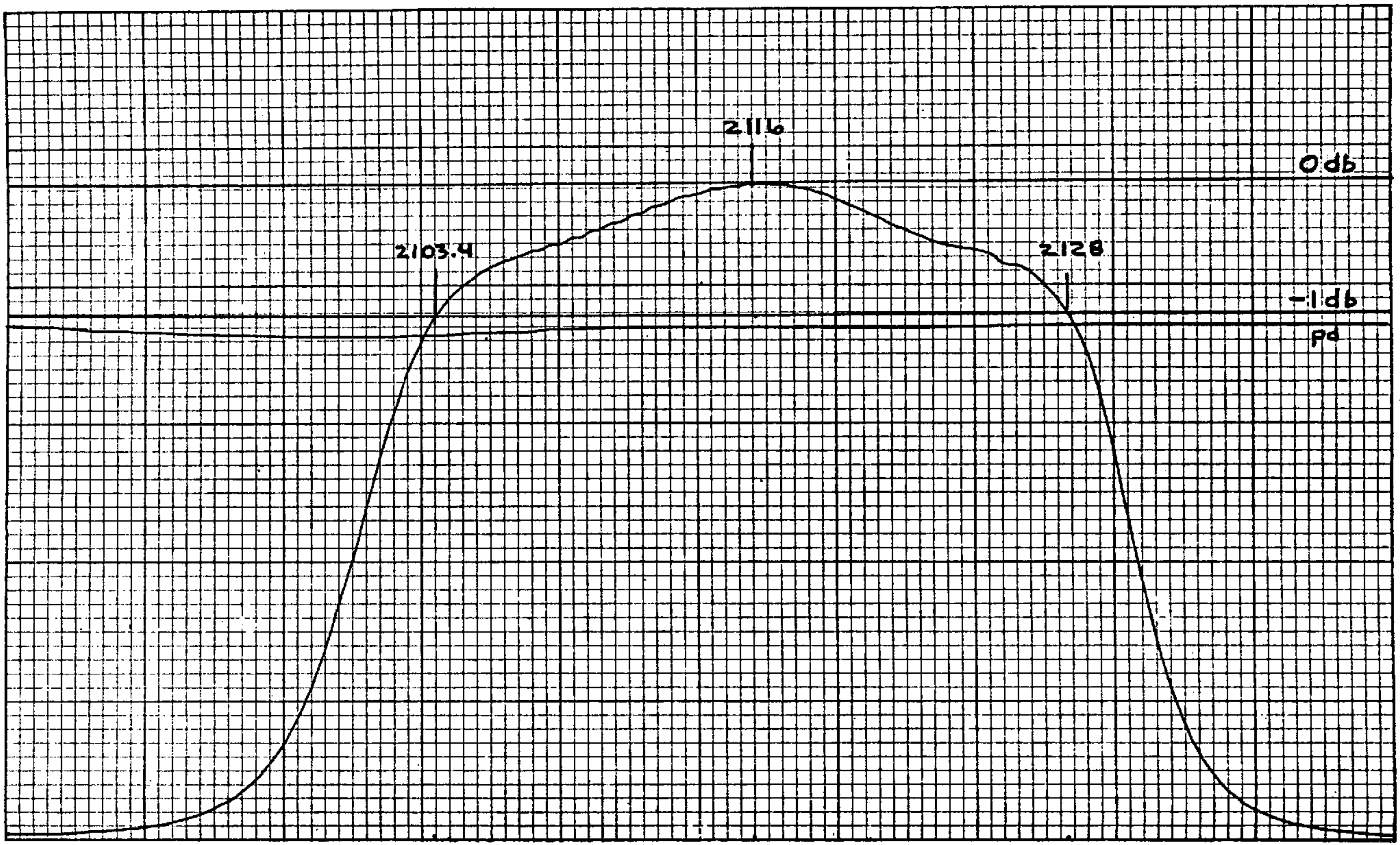
Customer QAR ______ Date ______

A	B	C	D	E
754	709	694	679	734

4240-10-25 8/72
TEST DATA SHEET

5K70SK WBT SERIAL NO. 1 CHANNEL 6 DATE: JULY 30 '73 BY: AAG

FILAMENT VOLTAGE	7.5	V	BEAM VOLTAGE	22	kV	POWER OUTPUT	25	kW
FILAMENT CURRENT	11.9	A	BEAM CURRENT	2.75	A	DRIVE POWER	615	mW
MAGNET CURRENT	17.7	A	BODY CURRENT	23	mA	GAIN	46.1	dB



FREQUENCY, MHz

TEST DATA SHEET

5K70SK WBT SERIAL NO. 1

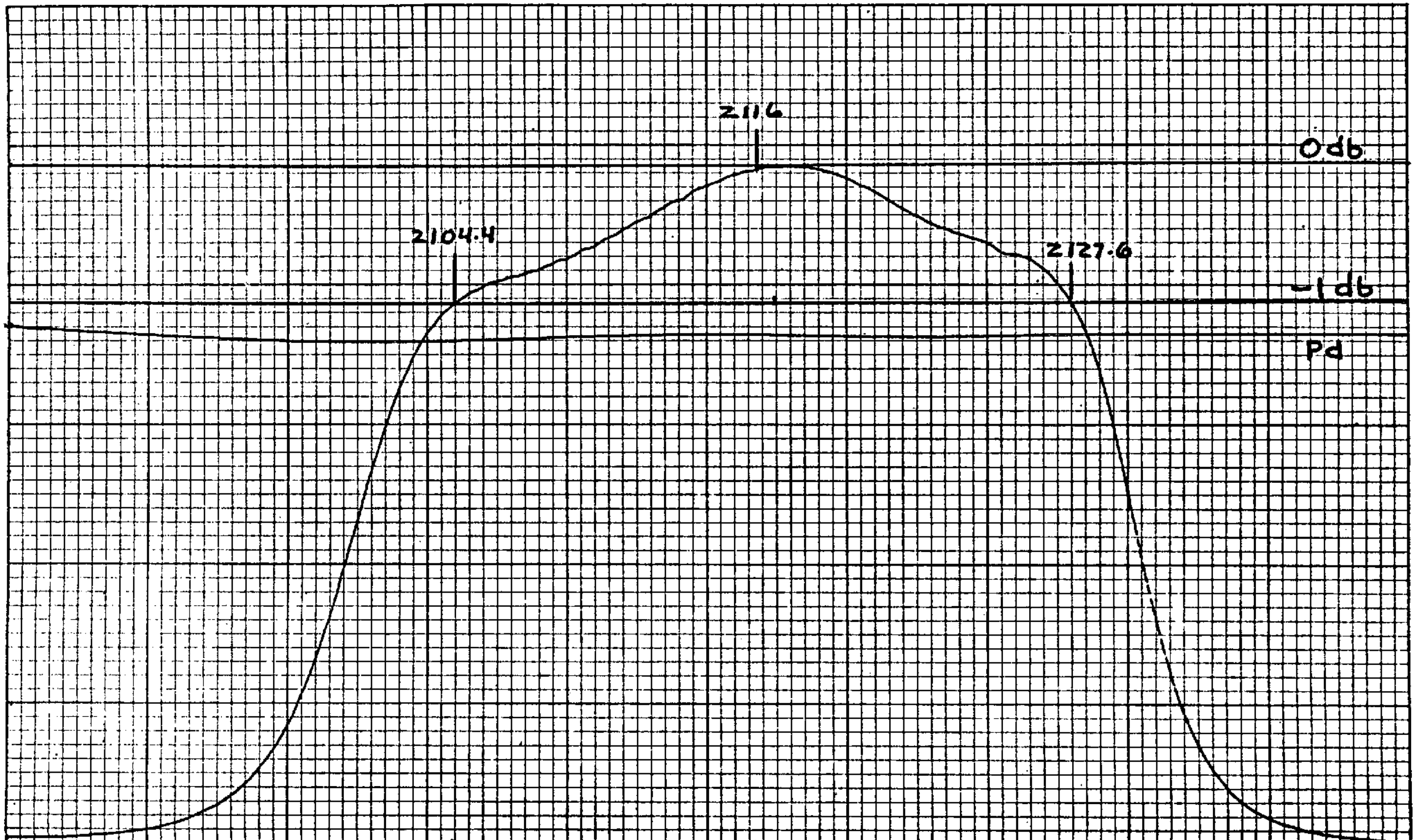
CHANNEL 6 RETRIEVE

DATE: JULY 31 '73 BY: AAG

FILAMENT VOLTAGE 7.5 V
FILAMENT CURRENT 11.9 A
MAGNET CURRENT 17.7 A

BEAM VOLTAGE 22 kV
BEAM CURRENT 2.75 A
BODY CURRENT 22 mA

POWER OUTPUT 25 kW
DRIVE POWER 610 mW
GAIN 46.1 dB



FREQUENCY, MHz

5K70SK-WBT

S/N 1

KLYSTRON

CHANNEL NO. 6 1.0KW

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2116	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.75	---	2.78	Adc
Collector Dissipation	P_{col}:	60.5	---	70	kW
Power Output	Po:	1.0	24	---	kW
Rf Input Power	Pd:	11.5	---	750	mW
Efficiency	E_{ff}:	1.65	39	---	%
Gain	Gain:	49.4	45	---	dB
Body Current	Iby:	10	---	75	mAdc
Bandwidth	Bw:	25.0	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.9	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	17.7	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-oz
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date July 30, 1973

Varian QAR [illegible] Date [illegible] 1973

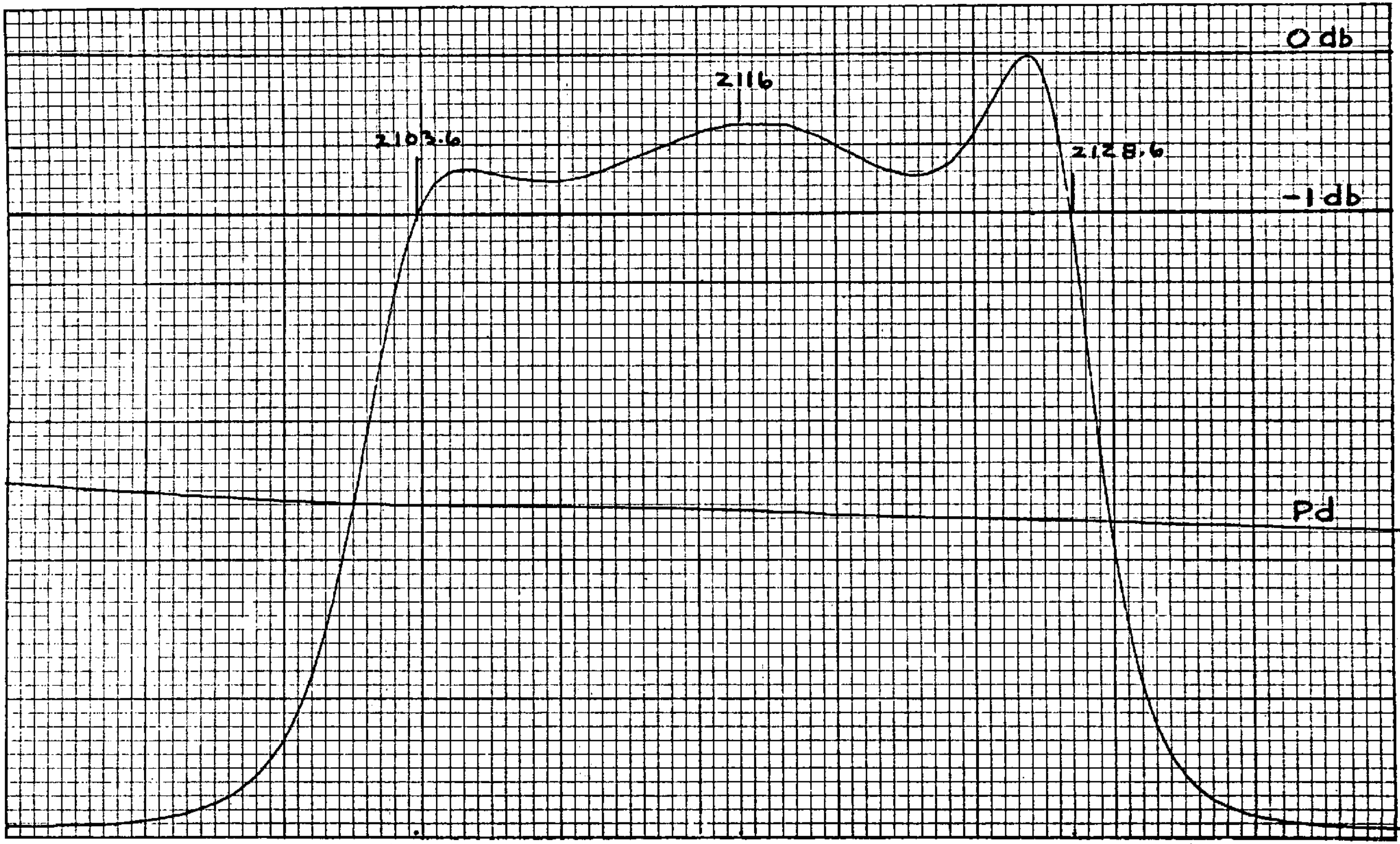
Customer QAR ______ Date ______

A	B	C	D	E
754	709	694	679	734

4240-10-25 8/72
TEST DATA SHEET

5K70SK WBT SERIAL NO. 1 CHANNEL 6 DATE: JULY 30 '73 BY: AAG

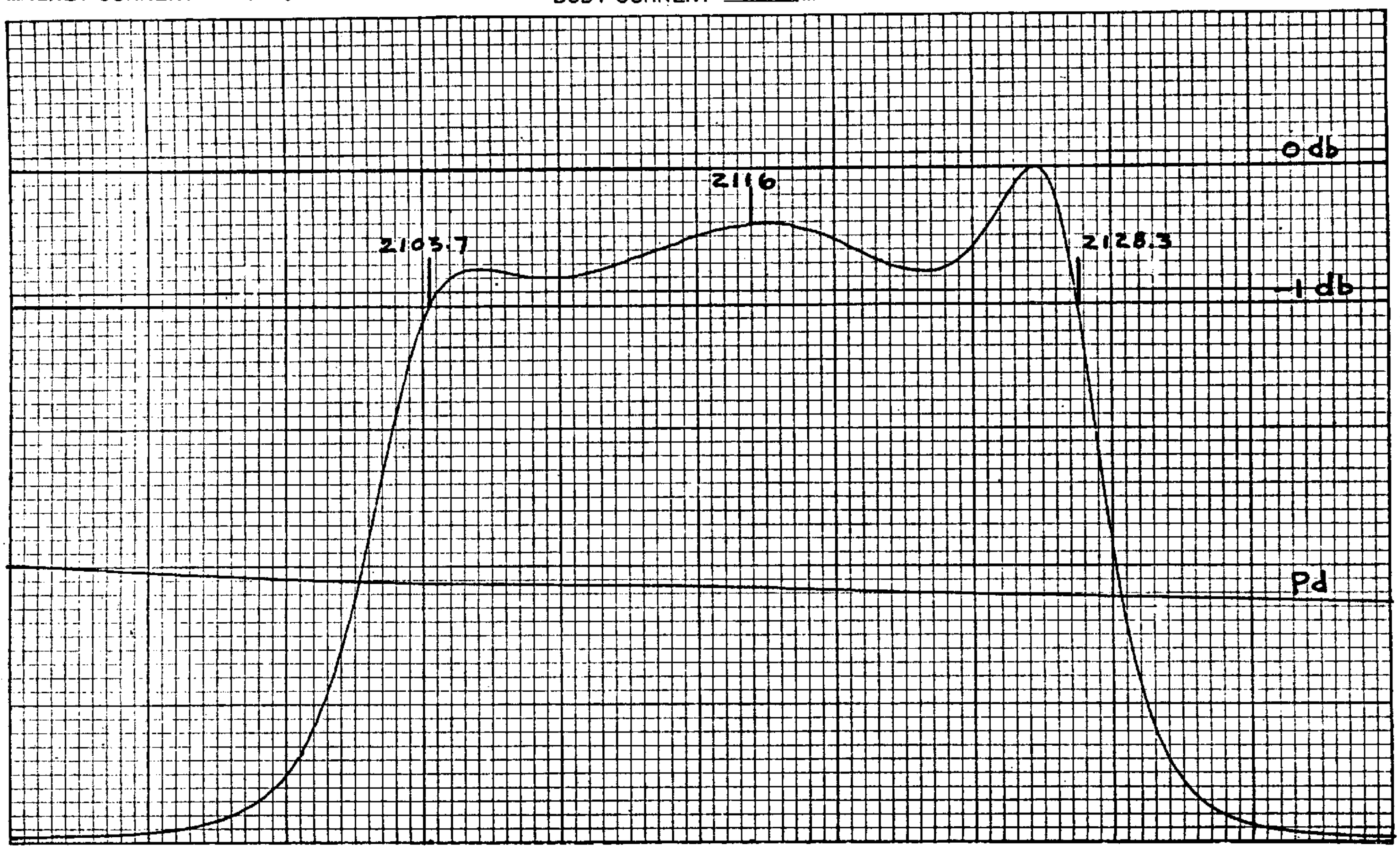
FILAMENT VOLTAGE	7.5	V	BEAM VOLTAGE	22	kV	POWER OUTPUT	1.0	kW
FILAMENT CURRENT	11.9	A	BEAM CURRENT	2.75	A	DRIVE POWER	11.5	mW
MAGNET CURRENT	17.7	A	BODY CURRENT	10	mA	GAIN	49.4	dB



FREQUENCY, MHz

5K70SK WBT SERIAL NO. 1 CHANNEL 6 RETRIEVE DATE: JULY 31 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22 kV	POWER OUTPUT	1.0 kW
FILAMENT CURRENT	11.9 A	BEAM CURRENT	2.75 A	DRIVE POWER	11.8 mW
MAGNET CURRENT	17.7 A	BODY CURRENT	10 mA	GAIN	49.3 dB



FREQUENCY, MHz

5K70SK-WBT
S/N 1

KLYSTRON

LINEARITY TEST

PARAMETERS			MIN.	MAX.	UNITS
Center Frequency	F_o	2065			
Frequency Separation	F_{sep}:	4.0	---	---	MHz
Frequency (1)	F_1:	$F_o + 2.0$	---	---	MHz
Power Output (F_1)	Po_{F_1}:	2.38	---	---	kW
Frequency (2)	F_2:	$F_o - 2.0$	---	---	MHz
Power Output (F_2)	Po_{F_2}:	2.38	---	---	kW
3rd Order Intermodulation	IM_3:	-34	- 30	---	dB

Tested By. Art Goldfinger Date July 27, 1973

Varian QAR [illegible] Date 7/31/73

Customer QAR H.P. Cox Date 7-27-73

5K70SK-WBT

KLYSTRON

S/N 1

WARM-UP, EMISSION AND TUNABILITY TESTS

PARAMETER	SYMBOL		MIN.	MAX.	UNITS
Warm-Up Time 5 Minutes	Po	24.5	24.0	---	kW

Comments:

Emission	Δ Ib	10	---	200	mAdc

Comments:

Tunability	Channel No. 1	✓	---	---
	Channel No. 2	✓		
	Channel No. 3	✓		
	Channel No. 4	✓		
	Channel No. 5	✓		
	Channel No. 6	✓		

Tested By: Art Goldfinger Date July 27, 1973

Varian QAR [illegible] Date 7/27/73

Customer QAR H. R. Coy Date 7-27-73

5K70SK-WBT
KLYSTRON
S/N 1

WATER FLOW, PRESSURE DROP AND STATIC PRESSURE DATA

PARAMETER	SYMBOL		MIN.	MAX.	UNITS
COLLECTOR					
Flow	Flow:	18.5	---	---	gpm
Pressure Drop	ΔP:	24.5	---	40	psi
BODY					
Flow	Flow:	1.2	---	---	gpm
Pressure Drop	ΔP:	16.0	---	65	psi
STATIC PRESSURE					
125 psig	---	✓	No Leakage		

Tested By: [illegible] Date 8/1/73

Varian QAR: [illegible] Date 8/1/73

Customer QAR: Date

TUBE TYPE 5K70SK-WBT
TUBE SERIAL Nº 1R-1
ZERO INDEX 4 TURNS FROM C.W. STOP

STEP TUNER THUMBWHEEL SETTING

CHANNEL	A	B	C	D	E
1	370	234	128	098	163
2	447	368	265	235	310
3	544	494	387	371	430
4	621	591	502	483	543
5	693	633	608	585	648
6	754	709	694	679	734

REV	DATE	CHANGE

varian engineering sketch

ENGINEER AAG
DATE 10/22/73
MATERIAL
JOB ORDER
SCALE
USE
SKETCH NO.

Varian

5K70SK-WBT S/N IR-1

KLYSTRON

TEST PERFORMANCE SHEET

CHANNEL NO. 1

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2031	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.74	---	2.78	Adc
Collector Dissipation	P_{col}:	60.4	---	70	kW
Power Output	Po:	25.0	24	---	kW
Rf Input Power	Pd:	400	---	750	mW
Efficiency	E_{ff}:	41.5	39	---	%
Gain	Gain:	47.95	45	---	dB
Body Current	Iby:	30.0	---	75	mAdc
Bandwidth	Bw:	23.0	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.0	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	18.0	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Toldfinger Date OCT 22, 1973

Varian QAR R. Jerch Date OCT 22, 1973

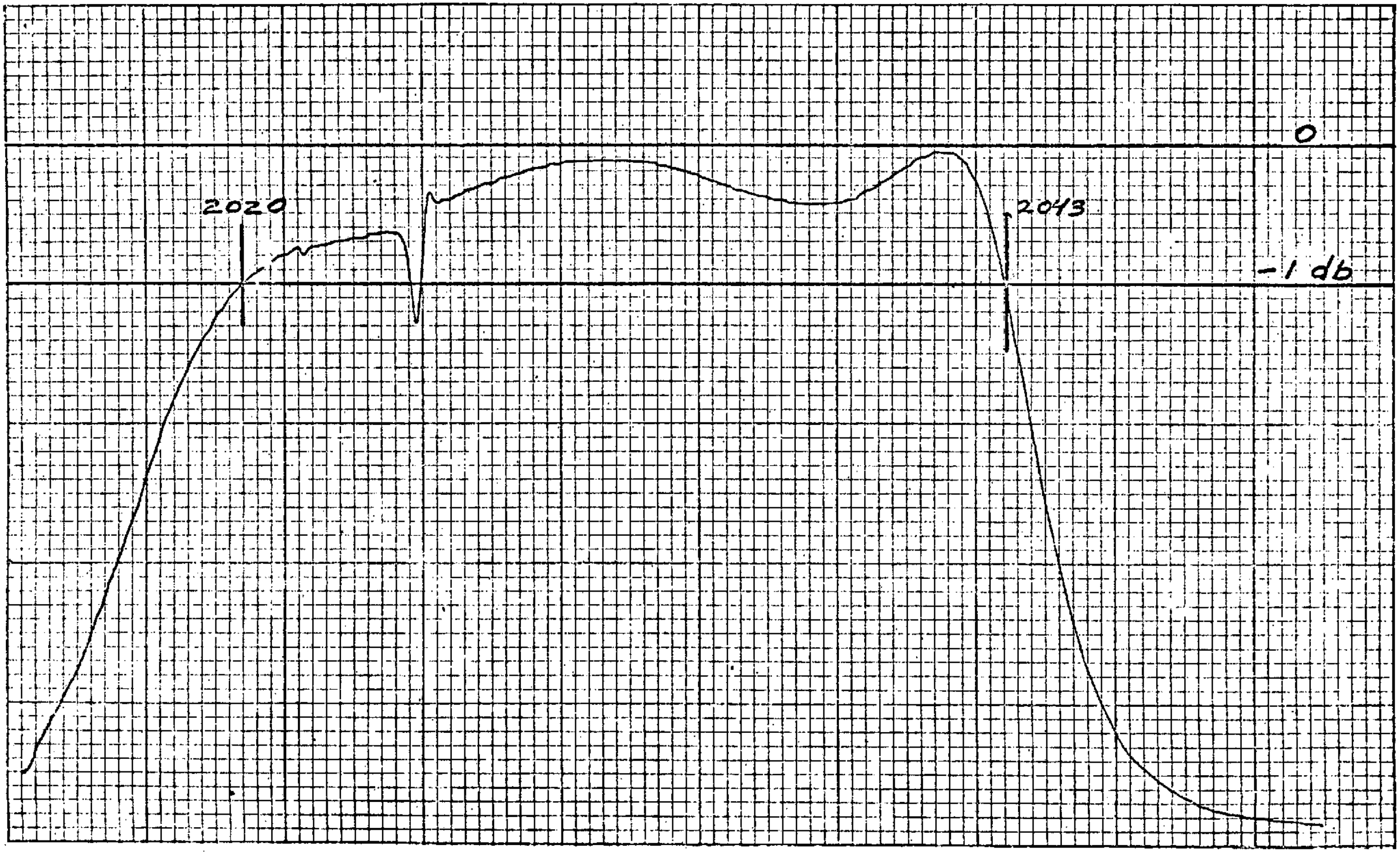
Customer QAR Date

A	B	C	D	E
363	200	102	073	136

4240-10-[illegible] 8/72
TEST D[illegible]EET

5K 70 5KWST SERIAL NO. 1R-1 | CHANNEL 1 | DATE: OCT 22 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22.0 kV	POWER OUTPUT	25.0 kW
FILAMENT CURRENT	11.0 A	BEAM CURRENT	2.74 A	DRIVE POWER	400 mW
MAGNET CURRENT	18.0 A	BODY CURRENT	30 mA	GAIN	47.95 dB



FREQUENCY, MHz

varian

5K70SK-WBT

S/N 1R-1

KLYSTRON

TEST PERFORMANCE SHEET

CHANNEL NO. 1

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2031	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.74	---	2.78	Adc
Collector Dissipation	P_{col}:	60.4	---	70	kW
Power Output	Po:	1.0	24	---	kW
Rf Input Power	Pd:	8.0	---	750	mW
Efficiency	E_{ff}:	1.65	~~39~~	---	%
Gain	Gain:	49.2	45	---	dB
Body Current	Iby:	12.0	---	75	mAdc
Bandwidth	Bw:	24.0	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.0	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	18.0	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date Oct 22, 1973

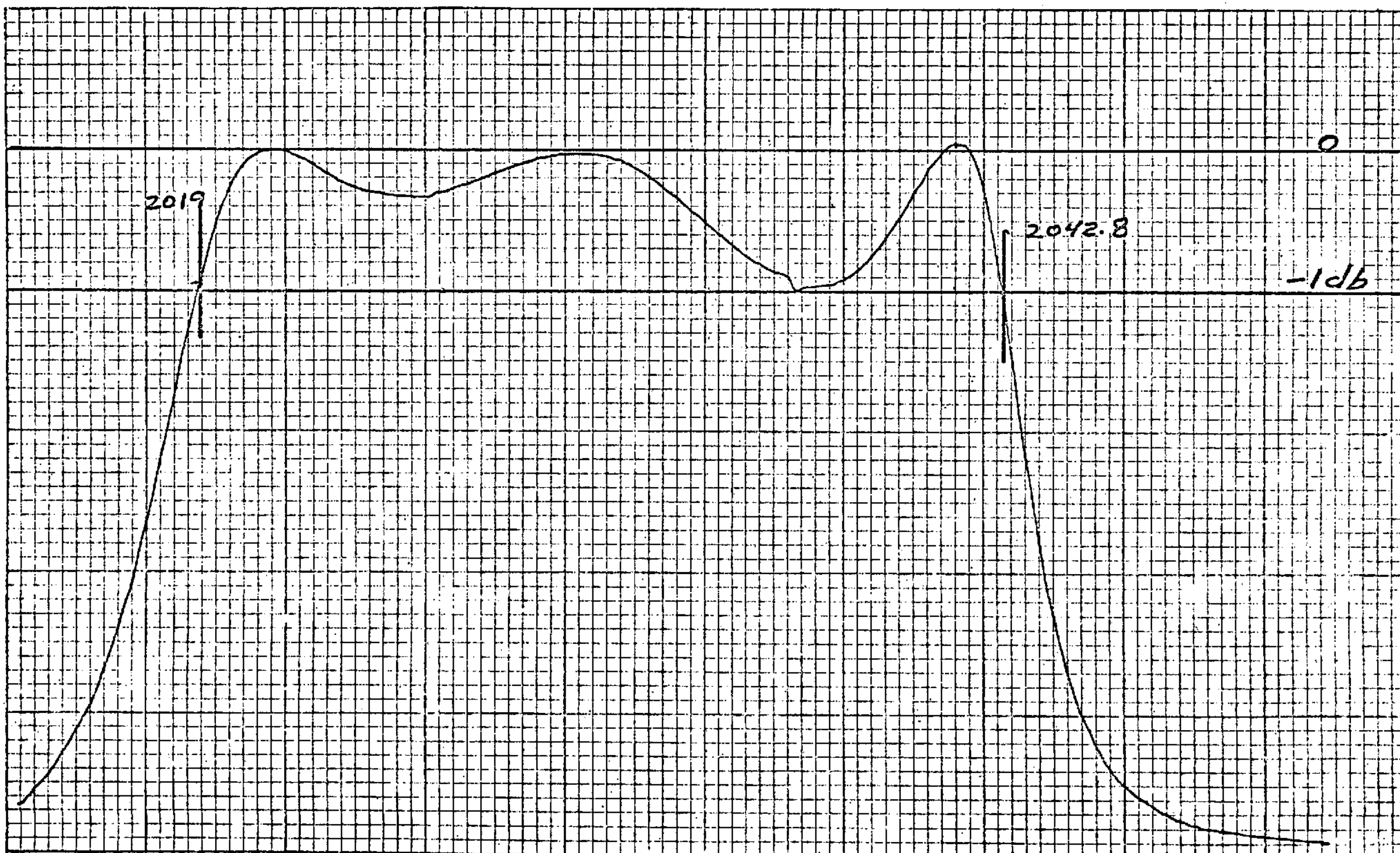
Varian QAR R. Jensen Date Oct 22, 1973

Customer QAR ____ Date ____

4240-10-29 6/72
TEST DATA SHEET

5K70SK WBT SERIAL NO. 1R-1 CHANNEL 1 DATE: OCT 22 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22.0 kV	POWER OUTPUT	1.0 kW
FILAMENT CURRENT	11.0 A	BEAM CURRENT	2.74 A	DRIVE POWER	8.5 mW
MAGNET CURRENT	18.0 A	BODY CURRENT	12 mA	GAIN	49.2 dB



FREQUENCY, MHz

varian

5K70SK-WBT	S/N 1R-1
KLYSTRON	

TEST PERFORMANCE SHEET

CHANNEL NO. 2

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2048	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.74	---	2.78	Adc
Collector Dissipation	P_{col}:	60.4	---	70	kW
Power Output	Po:	25.0	24	---	kW
Rf Input Power	Pd:	520	---	750	mW
Efficiency	E_{ff}:	41.5	39	---	%
Gain	Gain:	46.8	45.	---	dB
Body Current	Iby:	22.0	---	75	mAdc
Bandwidth	Bw:	24.5	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.0	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	18.0	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	ΔG:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date Oct 22, 1973

Varian QAR R. Jensen Date Oct 22, 1973

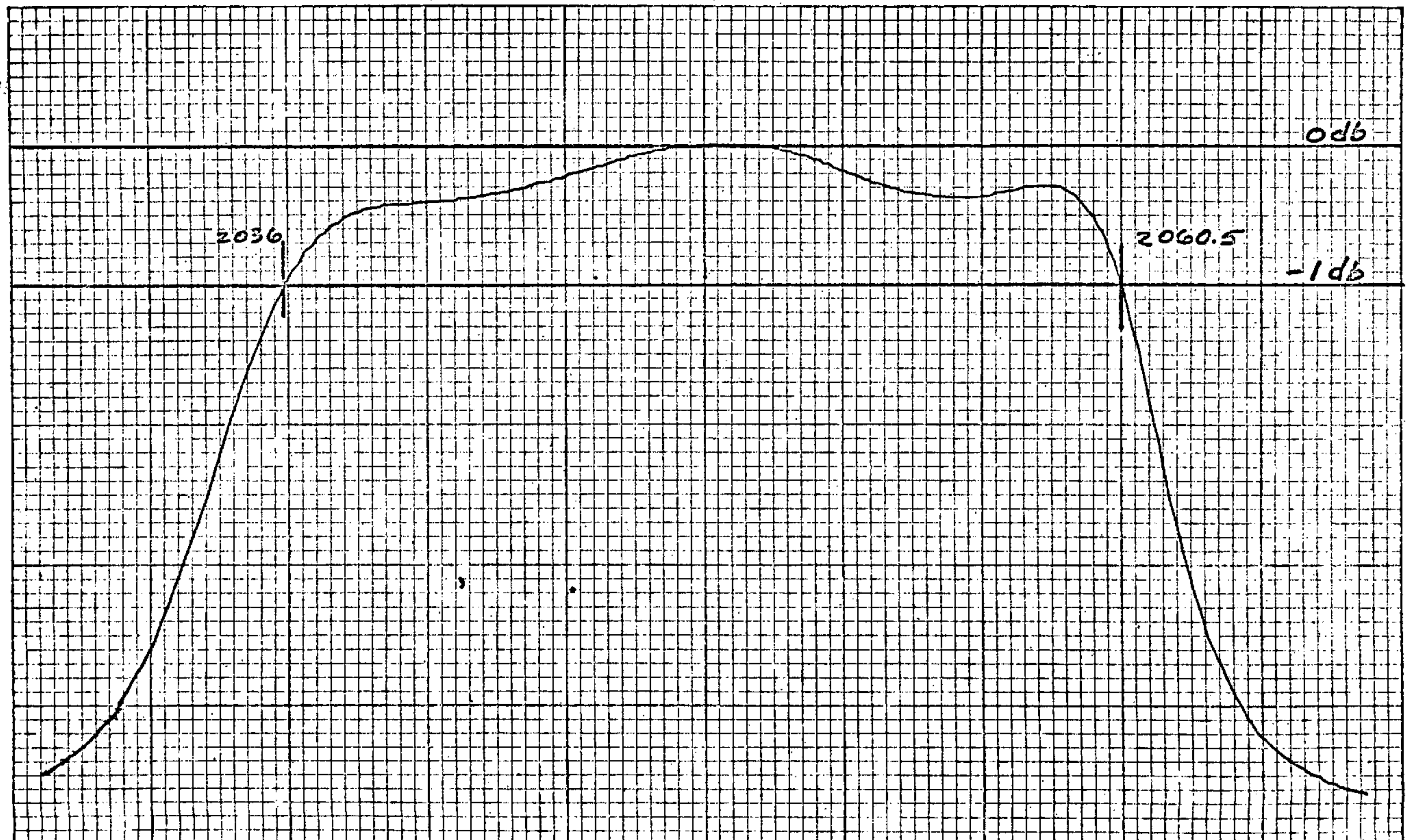
Customer QAR ______ Date ______

A	B	C	D	E
460	368	265	235	310

4240-10-25 8/72
TEST [illegible] SHEET

5K70SKWBT SERIAL NO. 1R-1 CHANNEL 2 DATE: OCT 22 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22 kV	POWER OUTPUT	25 kW
FILAMENT CURRENT	11.0 A	BEAM CURRENT	2.74 A	DRIVE POWER	520 mW
MAGNET CURRENT	18.0 A	BODY CURRENT	22 mA	GAIN	46.8 dB



FREQUENCY, MHz

varian

5K70SK-WBT

S/N IR-1

KLYSTRON

CHANNEL NO. 2

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2048	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.74	---	2.78	Adc
Collector Dissipation	P_{col}:	60.4	---	70	kW
Power Output	Po:	1.0	24	---	kW
Rf Input Power	Pd:	10.5	---	750	mW
Efficiency	E_{ff}:	1.65	39	---	%
Gain	Gain:	49.8	45	---	dB
Body Current	Iby:	17	---	75	mAdc
Bandwidth	Bw:	24.5	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.0	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	18.0	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

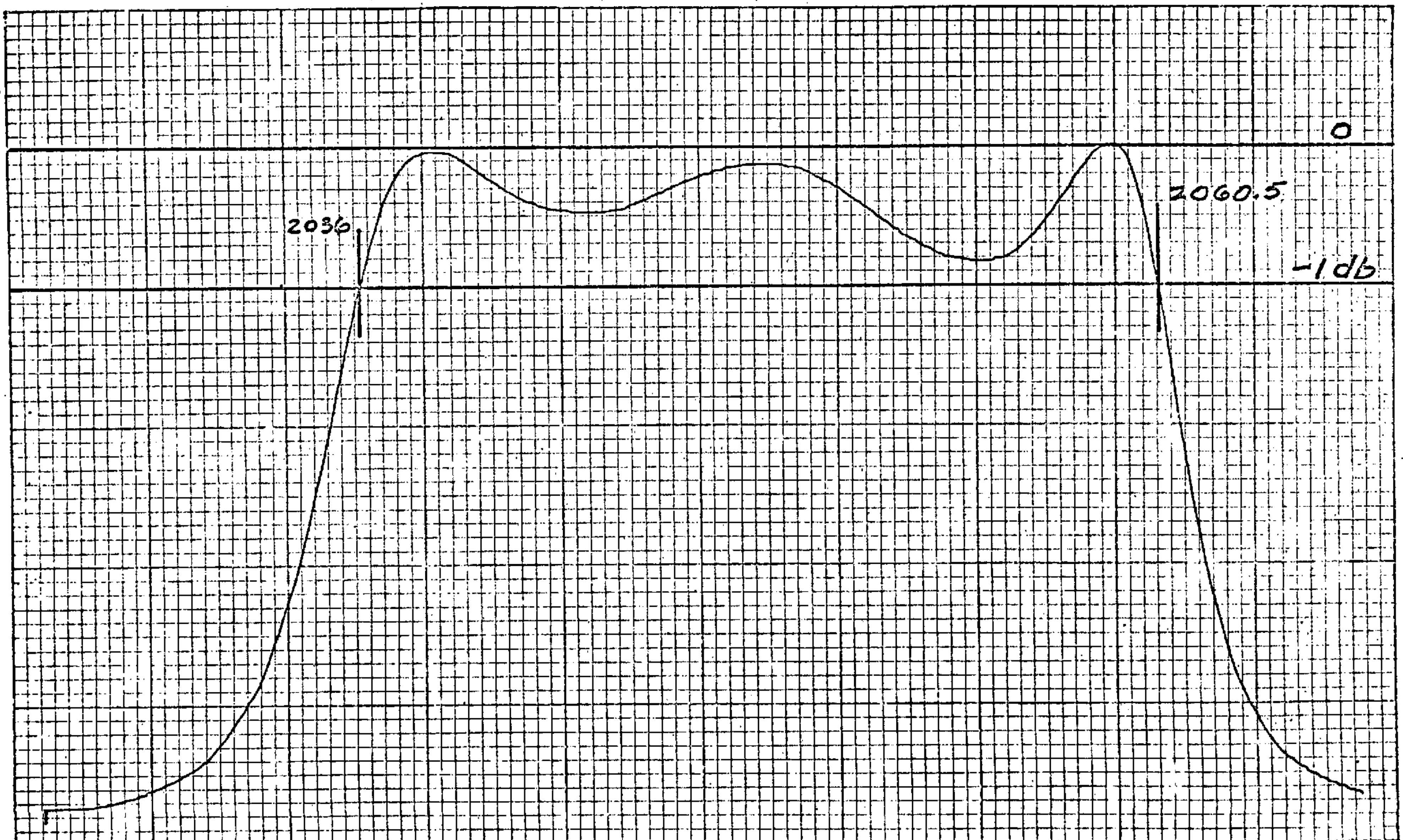
Tested By: Art Goldfinger Date Oct 22, 1973

Varian QAR R. Jensen Date Oct 22, 1973

Customer QAR ______ Date ______

5K70SK WBT SERIAL NO. 1R-1 CHANNEL 2 DATE: OCT 22 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22 kV	POWER OUTPUT	1.0 kW
FILAMENT CURRENT	11.0 A	BEAM CURRENT	2.74 A	DRIVE POWER	10.5 mW
MAGNET CURRENT	18.0 A	BODY CURRENT	17 mA	GAIN	49.8 dB



FREQUENCY, MHz

varian

TEST PERFORMANCE SHEET

5K70SK-WBT

S/N IR-1

KLYSTRON

CHANNEL NO. 3

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2065	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.74	---	2.78	Adc
Collector Dissipation	P_{col}:	60.4	---	70	kW
Power Output	Po:	25.0	24	---	kW
Rf Input Power	Pd:	500	---	750	mW
Efficiency	E_{ff}:	41.5	39	---	%
Gain	Gain:	47.0	45	---	dB
Body Current	Iby:	25	---	75	mAdc
Bandwidth	Bw:	24.5	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.0	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	18.0	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date Oct 22, 1973

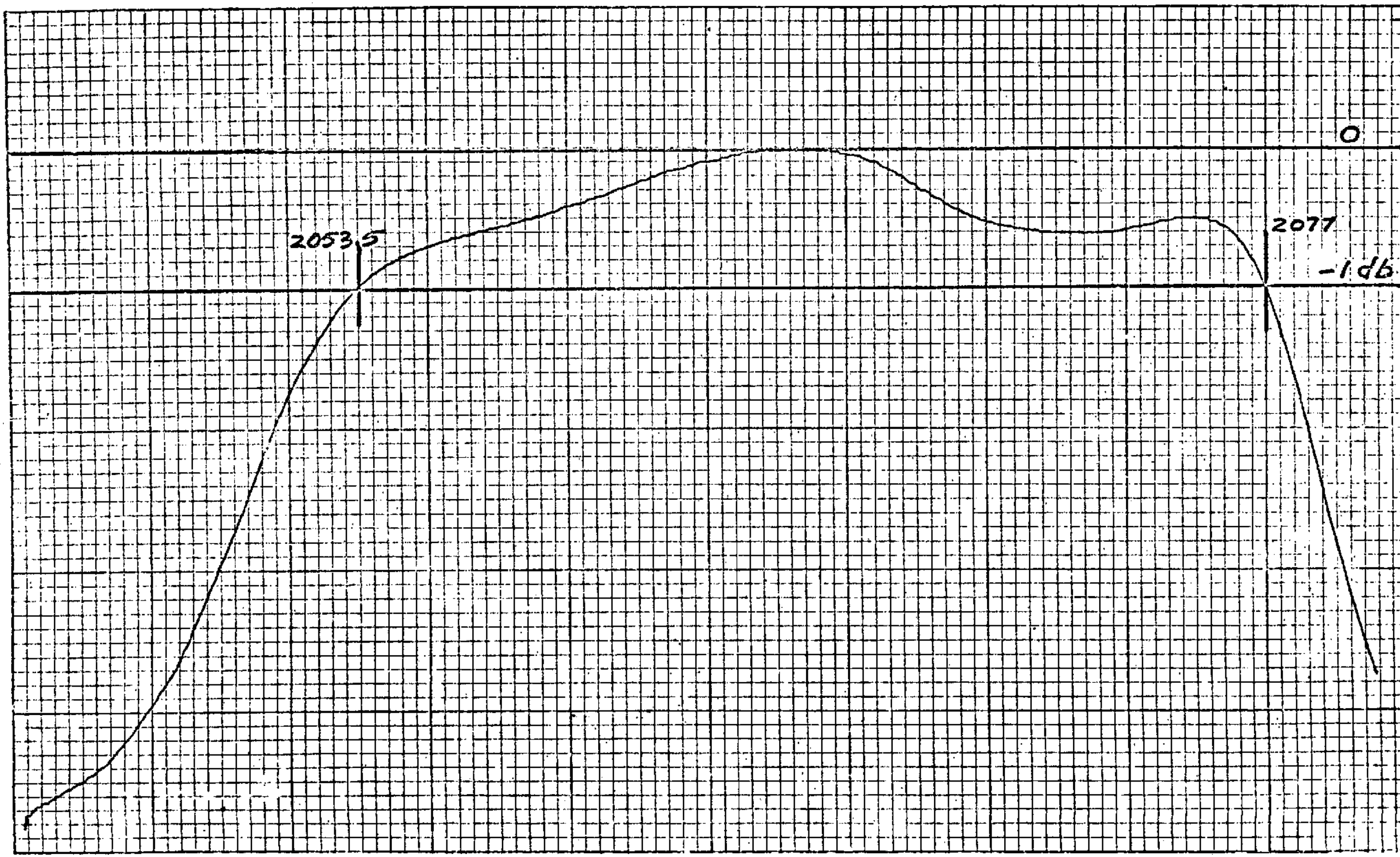
Varian QAR R. Jensen Date Oct 22, 1973

Customer QAR ______ Date ______

4240-10-25 8/72
TEST DATA SHEET

5K70SK WCT SERIAL NO. 1R-1 CHANNEL 3 DATE: OCT 22 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22 kV	POWER OUTPUT	25 kW
FILAMENT CURRENT	11.0 A	BEAM CURRENT	2.74 A	DRIVE POWER	500 mW
MAGNET CURRENT	18.0 A	BODY CURRENT	25 mA	GAIN	47.0 dB



FREQUENCY, MHz

varian

5K70SK-WBT	S/N 1R-1
KLYSTRON	

CHANNEL NO. 3

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2065	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.74	---	2.78	Adc
Collector Dissipation	P_{col}:	60.4	---	70	kW
Power Output	Po:	1.0	24	---	kW
Rf Input Power	Pd:	10.5	---	750	mW
Efficiency	E_{ff}:	1.65	~~33~~	---	%
Gain	Gain:	49.8	45	---	dB
Body Current	Iby:	15	---	75	mAdc
Bandwidth	Bw:	25.5	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.0	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	18.0	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF	< 35 db	---	35	dB
" "		< 30 db above THERMAL			

Tested By: Art Goldfinger Date Oct 23, 1973

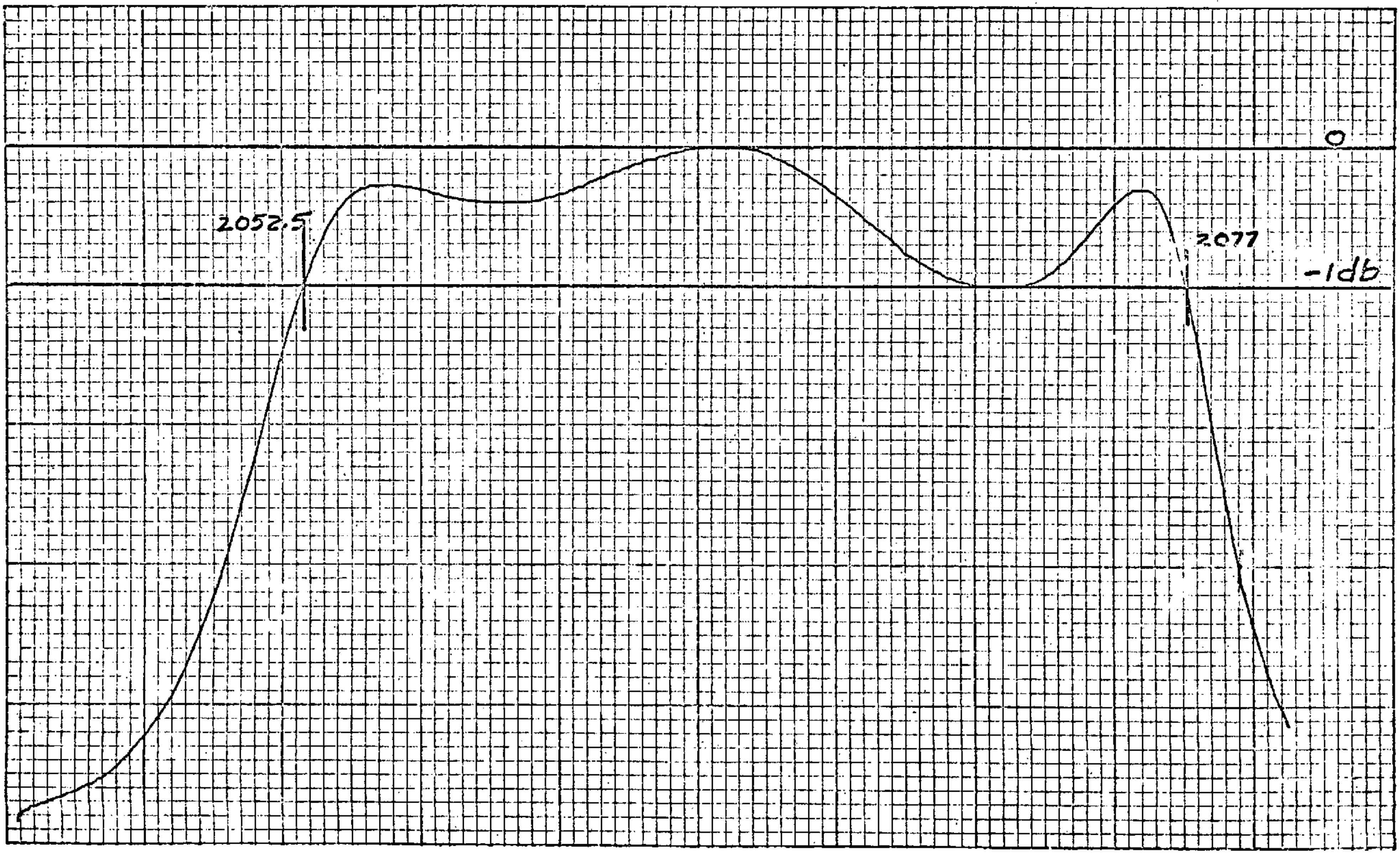
Varian QAR R. Jensen Date Oct 23, 1973

Customer QAR ______ Date ______

4240-10-25 8/72
TEST DA[illegible]EET

5K70SK WBT SERIAL NO. 1R-1 CHANNEL 3 DATE: OCT 22 '73 BY: AAG

FILAMENT VOLTAGE	7.5	V	BEAM VOLTAGE	22	kV	POWER OUTPUT	1.0	kW
FILAMENT CURRENT	11.0	A	BEAM CURRENT	2.74	A	DRIVE POWER	10.5	mW
MAGNET CURRENT	18.0	A	BODY CURRENT	17	mA	GAIN	49.8	dB



FREQUENCY, MHz

varian

5K70SK-WBT

S/N 1R-1

KLYSTRON

TEST PERFORMANCE DATA

CHANNEL NO. 4

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2082	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.74	---	2.78	Adc
Collector Dissipation	P_{col}:	60.4	---	70	kW
Power Output	Po:	25.0	24	---	kW
Rf Input Power	Pd:	560	---	750	mW
Efficiency	E_{ff}:	41.5	39	---	%
Gain	Gain:	46.5	45	---	dB
Body Current	Iby:	30	---	75	mAdc
Bandwidth	Bw:	23.3	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.0	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	18.0	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	ΔG:	<0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

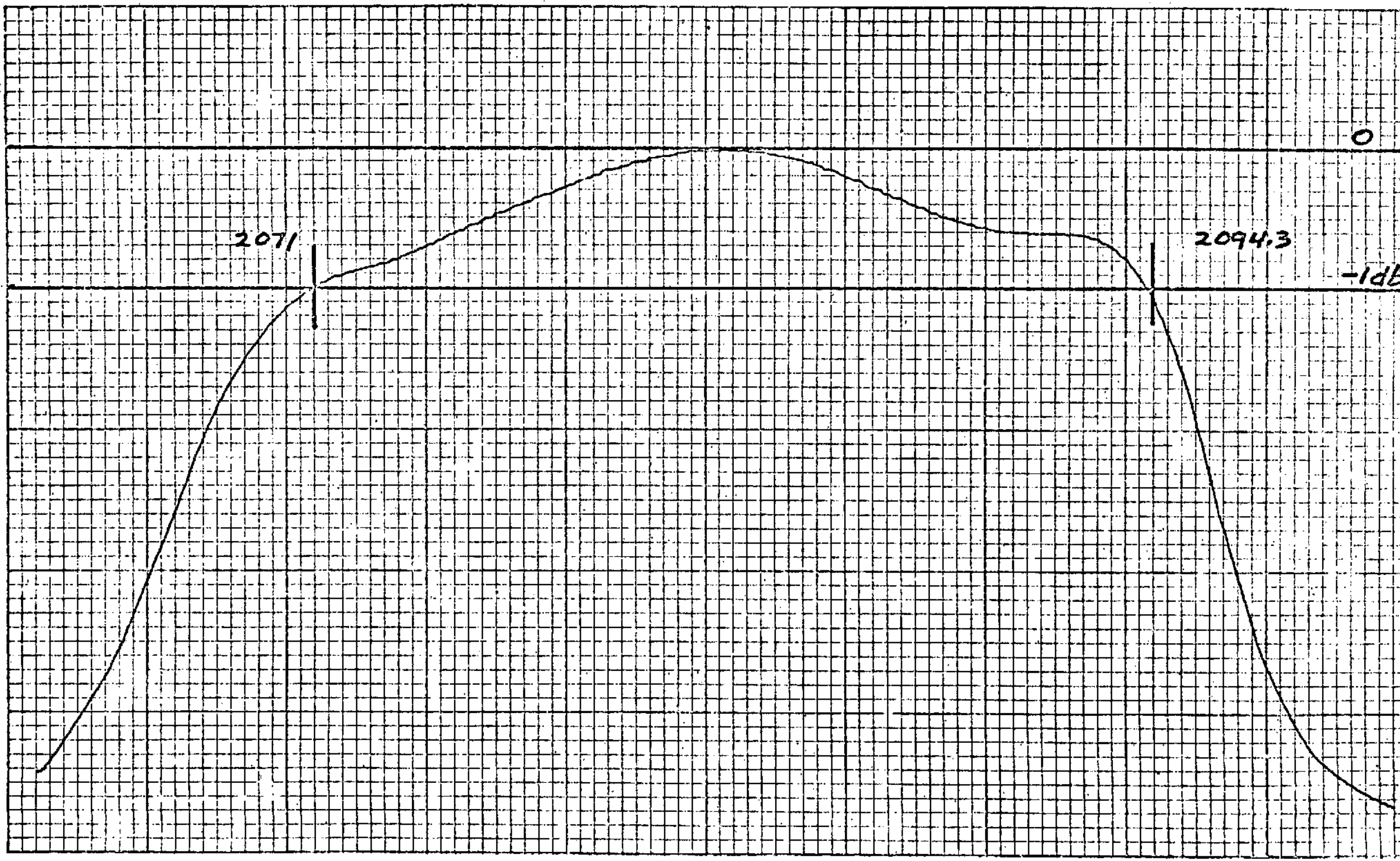
Tested By: Art Goldfinger Date OCT 22, 1973

Varian QAR R. Jensen Date Oct 22, 1973

Customer QAR Date

5K70SK WBT SERIAL NO. 1R-1 | CHANNEL 4 | DATE: OCT 23 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22 kV	POWER OUTPUT	25 kW
FILAMENT CURRENT	11.0 A	BEAM CURRENT	2.74 A	DRIVE POWER	560 mW
MAGNET CURRENT	18.0 A	BODY CURRENT	30 mA	GAIN	46.5 dB



FREQUENCY, MHz

Varian

5K70SK-WBT

S/N IR-1

KLYSTRON

CHANNEL NO. 4

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2082	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.74	---	2.78	Adc
Collector Dissipation	P_{col}:	60.4	---	70	kW
Power Output	Po:	1.0	24	---	kW
Rf Input Power	Pd:	11.3	---	750	mW
Efficiency	E_{ff}:	1.65	39	---	%
Gain	Gain:	49.4	45	---	dB
Body Current	Iby:	12	---	75	mAdc
Bandwidth	Bw:	24.5	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.0	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	18.0	---	25	Adc
Tuner Torque	Tor:	<80	---	80	in-oh
Amplitude Response	Δ G:	<0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date OCT 22, 1973

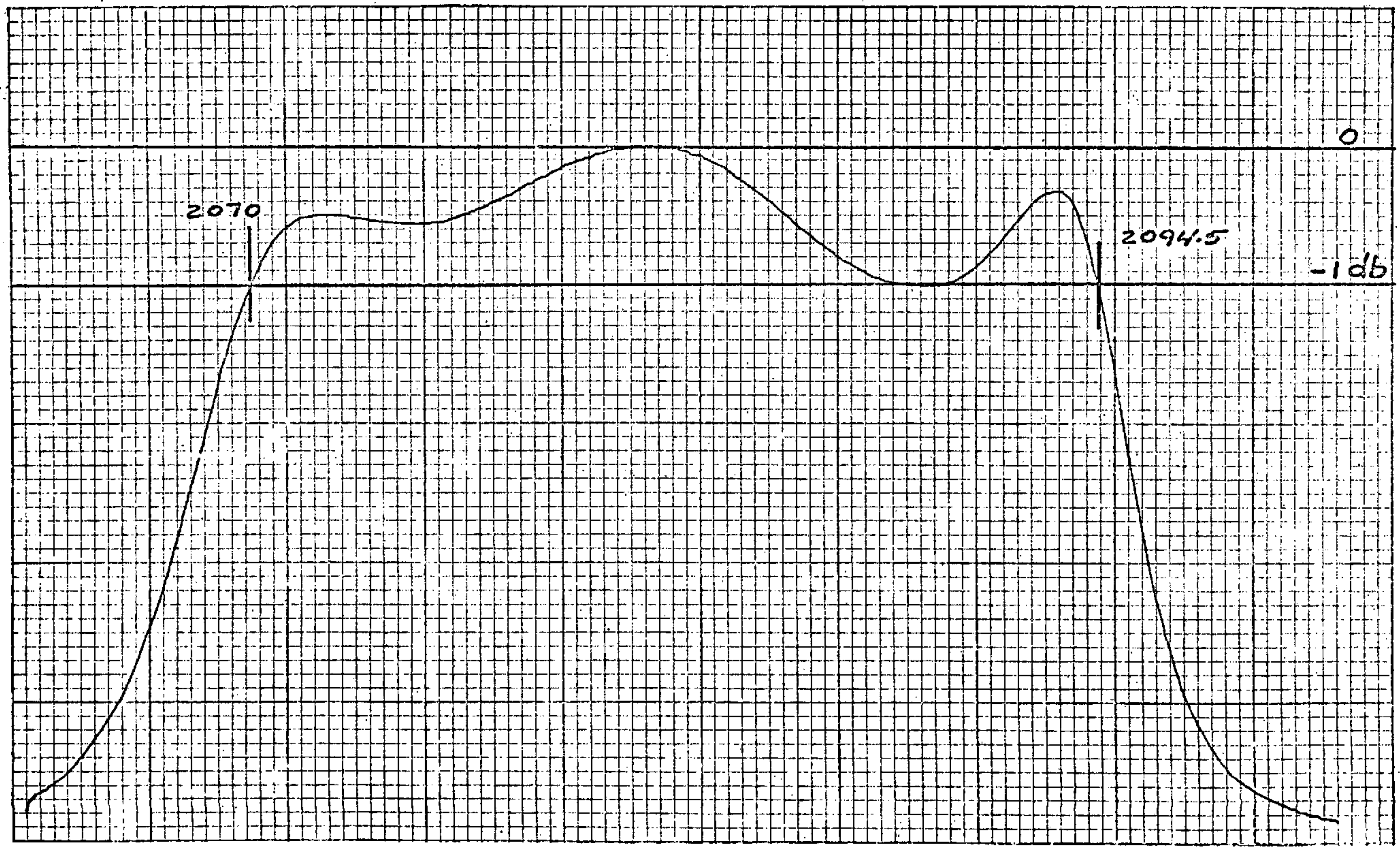
Varian QAR R. Jensen Date OCT 22, 1973

Customer QAR Date

4240-10-25 8/72
TEST DATA SHEET

SK705K WBT SERIAL NO. 1R-1 CHANNEL 4 DATE: OCT 23 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V		BEAM VOLTAGE	22 kV		POWER OUTPUT	1.0 kW
FILAMENT CURRENT	11.0 A		BEAM CURRENT	2.74 A		DRIVE POWER	11.3 mW
MAGNET CURRENT	18.0 A		BODY CURRENT	12 mA		GAIN	49.4 dB



FREQUENCY, MHz

varian

5K70SK-WBT

S/N 1R-1

KLYSTRON

TEST DATA SHEET

CHANNEL NO. 5

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2099	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.74	---	2.78	Adc
Collector Dissipation	P_{col}:	60.4	---	70	kW
Power Output	Po:	25.0	24	---	kW
Rf Input Power	Pd:	450	---	750	mW
Efficiency	E_{ff}:	41.5	39	---	%
Gain	Gain:	47.4	45	---	dB
Body Current	Iby:	30	---	75	mAdc
Bandwidth	Bw:	23.2	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.0	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	18.0	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date Oct 23, 1973

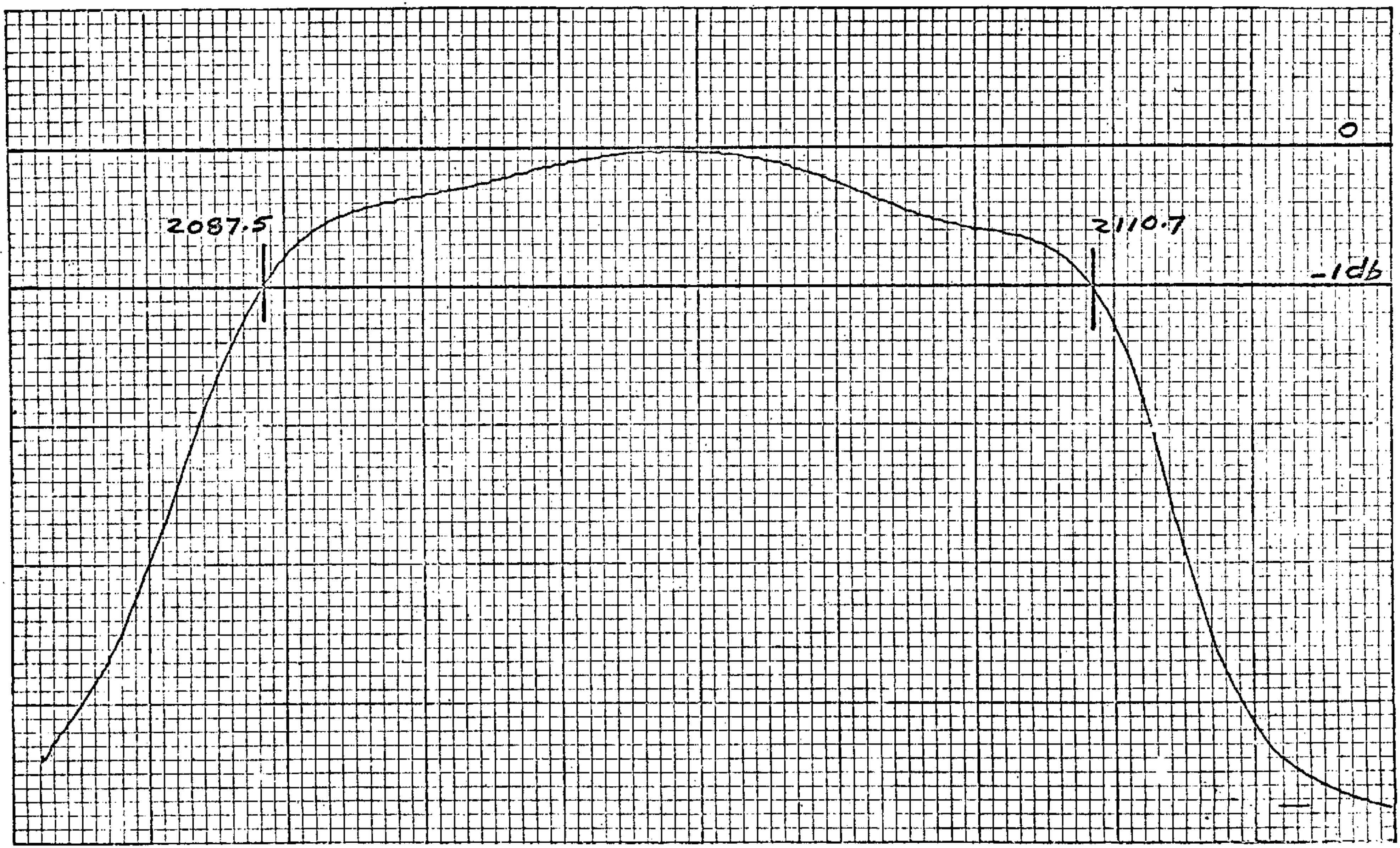
Varian QAR R. Jensen Date Oct 23, 1973

Customer QAR Date

4240-10-25 6/72
TE ATA-SHEET

5K70SK WBT SERIAL NO. 1R-1 | CHANNEL 5 | DATE: OCT 23 '73 BY: AAG

FILAMENT VOLTAGE	7.5	V	BEAM VOLTAGE	22	kV	POWER OUTPUT	25	kW
FILAMENT CURRENT	11.0	A	BEAM CURRENT	2.74	A	DRIVE POWER	450	mW
MAGNET CURRENT	18.0	A	BODY CURRENT	30	mA	GAIN	47.4	dB



FREQUENCY, MHz

5K70SK-WBT

S/N 1R-1

KLYSTRON

CHANNEL NO. 5

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2099	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.74	---	2.78	Adc
Collector Dissipation	P_{col}:	60.4	---	70	kW
Power Output	Po:	1.0	24	---	kW
Rf Input Power	Pd:	9.4	---	750	mW
Efficiency	E_{ff}:	1.65	[illegible]	---	%
Gain	Gain:	50.3	45	---	dB
Body Current	Iby:	12.0	---	75	mAdc
Bandwidth	Bw:	24.5	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.0	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	18.0	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date Oct 23, 1973

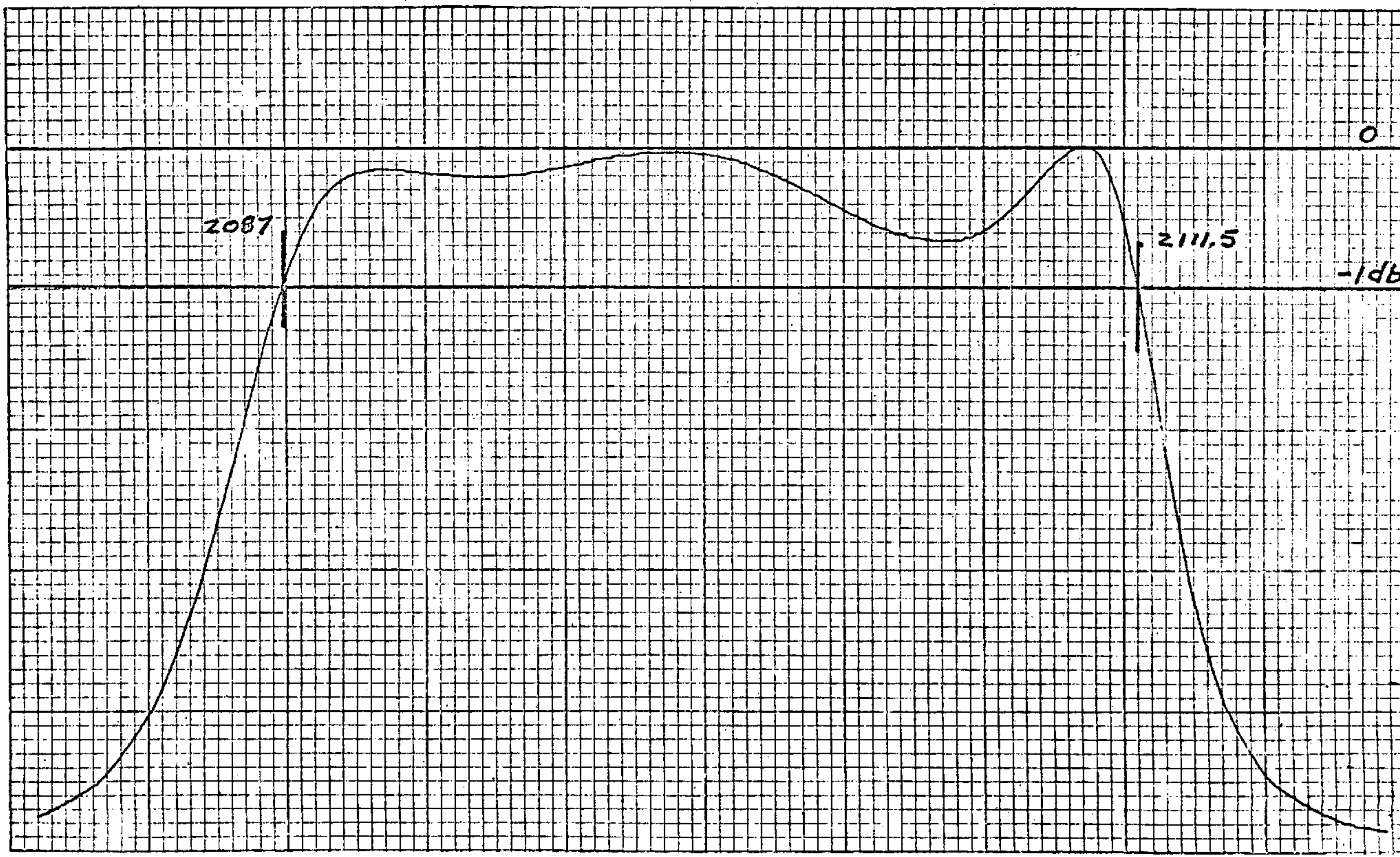
Varian QAR R. Jensen Date Oct 23, 1973

Customer QAR ____________ Date ____________

4240-10-25 8/72
T ATA SHEET

5K70SK WBT SERIAL NO. 1R-1 CHANNEL 5 DATE: OCT 23 '73 BY: AAG

FILAMENT VOLTAGE	7.5	V	BEAM VOLTAGE	22	kV	POWER OUTPUT	1.0	kW
FILAMENT CURRENT	11.0	A	BEAM CURRENT	2.74	A	DRIVE POWER	9.4	mW
MAGNET CURRENT	18.0	A	BODY CURRENT	12	mA	GAIN	50.3	dB



FREQUENCY, MHz

varian

5K70SK-WB1

S/N 1R-1

KLYSTRON

TEST RECORD

CHANNEL NO. 6

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2116	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.74	---	2.78	Adc
Collector Dissipation	P_{col}:	60.4	---	70	kW
Power Output	Po:	25.0	24	---	kW
Rf Input Power	Pd:	490	---	750	mW
Efficiency	E_{ff}:	41.5	39	---	%
Gain	Gain:	47.1	45	---	dB
Body Current	Iby:	30	---	75.	mAdc
Bandwidth	Bw:	23.5	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.0	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	18.0	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

Tested By: Art Goldfinger Date Oct 23, 1973

Varian QAR R. Jensen Date Oct 23, 1973

Customer QAR ______ Date ______

4240-10-25 8/72
TEST DATA SHEET

5K70SKWBT SERIAL NO. 1R-1

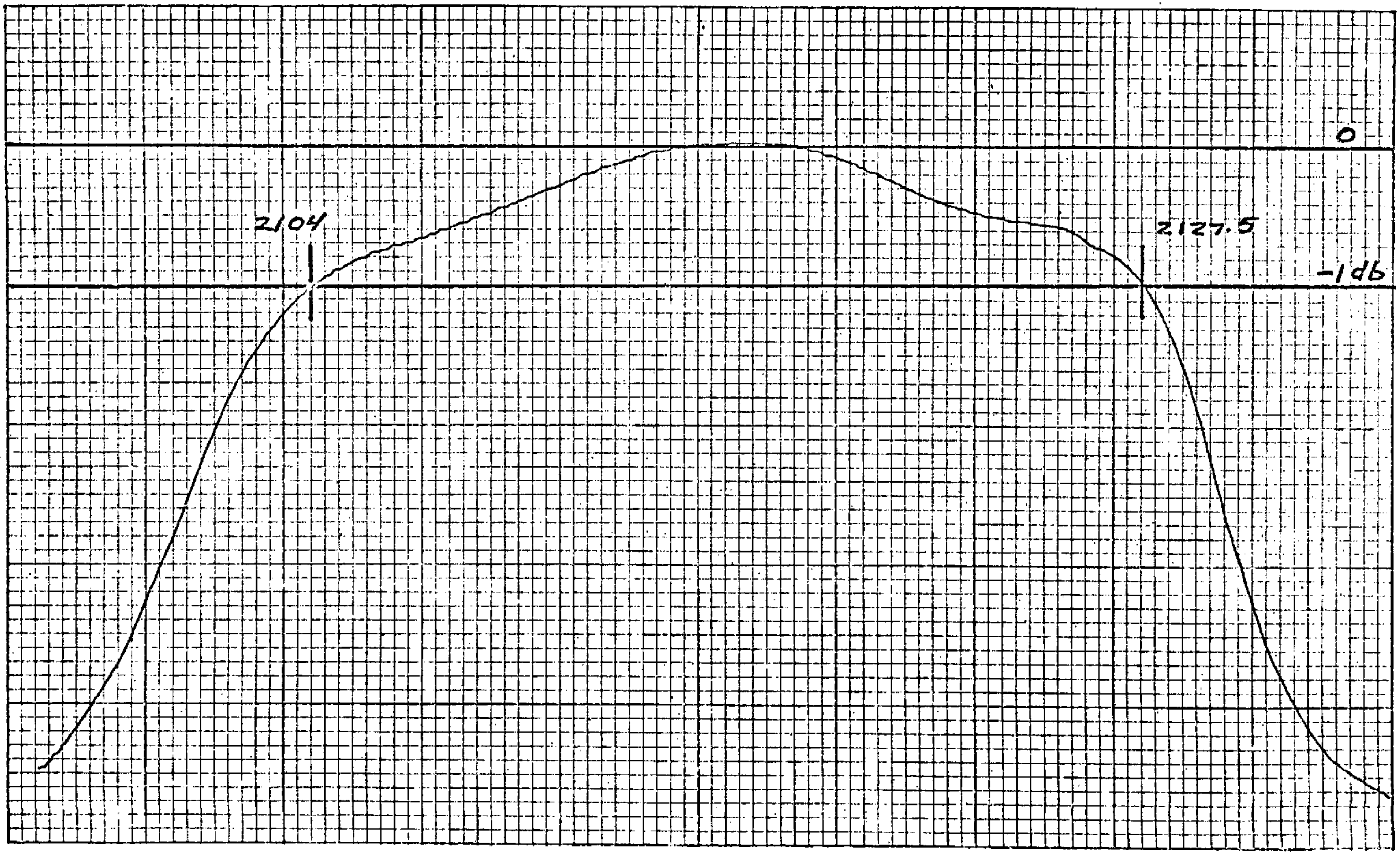
CHANNEL 6

DATE: OCT 23 '73 BY: AAG

FILAMENT VOLTAGE 7.5 V
FILAMENT CURRENT 11.0 A
MAGNET CURRENT 18.0 A

BEAM VOLTAGE 22 kV
BEAM CURRENT 2.74 A
BODY CURRENT 30 mA

POWER OUTPUT 25 kW
DRIVE POWER 490 mW
GAIN 47.1 dB



FREQUENCY, MHz

5K70SK-WBT

S/N IR-1

KLYSTRON

CHANNEL NO. 6

POWER OUTPUT, BANDWIDTH, EFFICIENCY AND GAIN

PARAMETER	SYMBOL		MIN	MAX	UNITS
Frequency	F:	2116	---	---	MHz
Beam Voltage	Eb:	22.0	---	22	kVdc
Beam Current	Ib:	2.74	---	2.78	Adc
Collector Dissipation	P_{col}:	60.4	---	70	kW
Power Output	Po:	1.0	24	---	kW
Rf Input Power	Pd:	10.1	---	750	mW
Efficiency	E_{ff}:	1.65	39	---	%
Gain	Gain:	49.6	45	---	dB
Body Current	Iby:	13	---	75	mAdc
Bandwidth	Bw:	24	22	---	MHz
Heater Voltage	Ef:	7.5	---	---	Vac
Heater Current	If:	11.0	9.5	13.0	Aac
Getter Current	I_{get}:	24.0	---	34.0	Aac
Magnet Current	Im:	18.0	---	25	Adc
Tuner Torque	Tor:	< 80	---	80	in-on
Amplitude Response	Δ G:	< 0.5	---	± 0.5	dB
Spurious Output	NF		---	35	dB

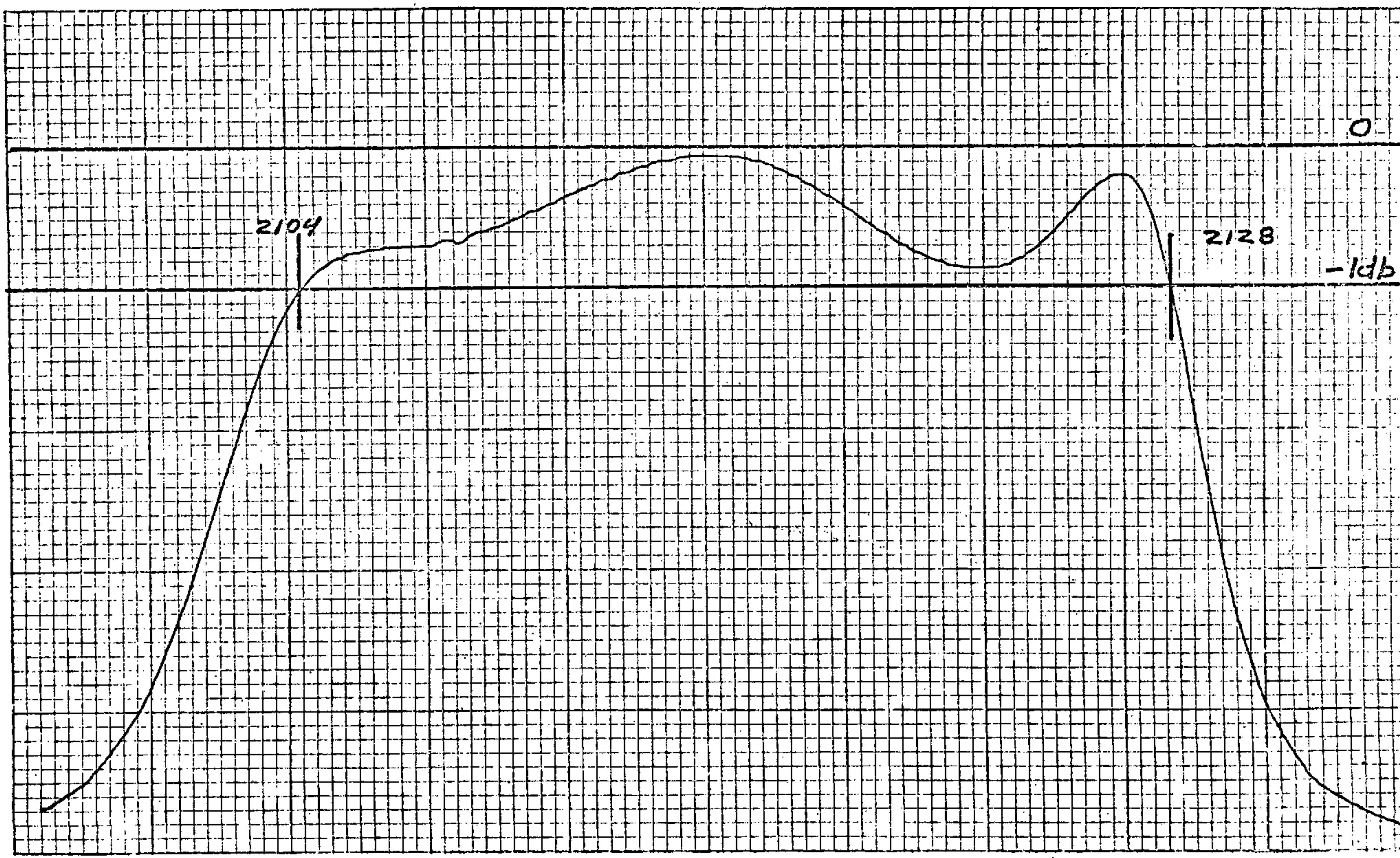
Tested By: Art Goldfinger Date Oct 23, 1973

Varian QAR R. Jensen Date Oct 23, 1973

Customer QAR Date

5K70SK WGT SERIAL NO. 1R-1 CHANNEL 6 DATE: OCT 23 '73 BY: AAG

FILAMENT VOLTAGE	7.5 V	BEAM VOLTAGE	22 kV	POWER OUTPUT	1.0 kW
FILAMENT CURRENT	11.0 A	BEAM CURRENT	2.74 A	DRIVE POWER	10.1 mW
MAGNET CURRENT	18.0 A	BODY CURRENT	13 mA	GAIN	49.6 dB



FREQUENCY, MHz