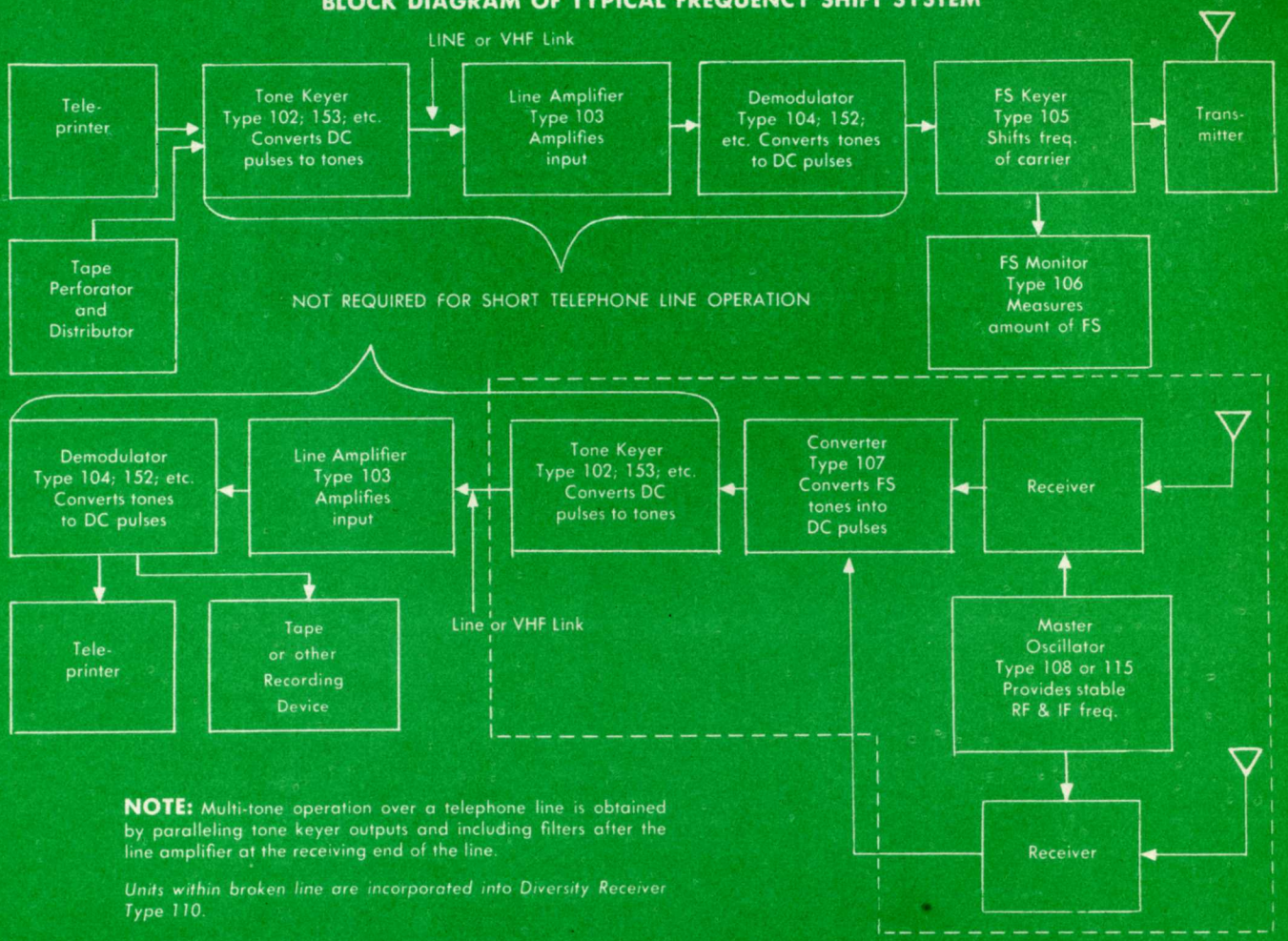
Complete Communications Engineering Service

Northern Radio Company, Inc. specializes in the engineering of communications systems. These systems can be furnished complete, including all terminal equipment, line channelizing systems, transmitters, receivers and antennas, designed specifically for point-to-point communications. We solicit your inquiries regarding this service.

Each unit in the Northern Radio Company line was designed, in cooperation with both government and commercial operating agencies, to fill the needs of the communications industry, and all are enjoying world-wide acceptance and application as outstanding performers in the field.

BLOCK DIAGRAM OF TYPICAL FREQUENCY SHIFT SYSTEM



NOTE: Multi-tone operation over a telephone line is obtained by paralleling tone keyer outputs and including filters after the line amplifier at the receiving end of the line.

Units within broken line are incorporated into Diversity Receiver Type 110.

NORTHERN RADIO COMPANY, inc.
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Pace-Setters in Quality Communication Equipment

the industry's foremost and complete line of quality communications equipment

TYPE 105, MODEL 4

NORTHERN RADIO

FREQUENCY SHIFT KEYER

PURPOSE: The Frequency Shift Keyer, Type 105 Model 4A with its Power Supply, Type 105 Model 4B, is a very high stability radio frequency oscillator which provides a means for shifting an RF carrier in accordance with the intelligence. This exciter replaces the crystal oscillator in a transmitter and produces "Mark" and "Space" carrier shift for transmission of teleprinter or telegraph signals or a linear carrier shift for transmission of F.M. telephone, facsimile or telephoto.

DESCRIPTION: The Frequency Shift Keyer is composed of five main sections, a keying circuit, reactance tube, shifted oscillator, crystal oscillator, modulator, and power amplifier. A keying signal, passing through the keying stage is limited in amplitude and then fed to the balanced reactance tube oscillator where it is used to vary the frequency in accordance with the applied intelligence. This shifted frequency is heterodyned with the output from the crystal oscillator in the modulator stage and the sum frequency is used to drive the power amplifier.

Present-day high-speed telegraph and teleprinter radio communication systems, especially multi-channel systems where separation *must* be maintained, require a higher degree of stability than previously required. To meet these requirements, concentrated effort has been given to the engineering design of the Type 105 Model 4 crystal oven. Optimum conditions of heat distribution, temperature control and mechanical and electrical operation are incorporated.

The new and novel features found in this unit are as follows:

1. Frequency shift dial, adjusts "mark" and "space" frequencies equally above and below the carrier position, which remains fixed.
2. Simplified Frequency setting makes only the upper sideband tuning indication visible on the meter over substantially all of the tuning range.
3. Direct reading frequency calibration of shift from 0 to 1000 cps.
4. Direct reading frequency calibration of mixer and output tuning dials from 2.5 to 6.7 mc.
5. Direct reading calibration of output frequency vernier ± 600 cps.
6. Pulse shaping circuit to permit operation within assigned bandwidth, with no adjacent channel radiation.
7. Highly stable temperature controlled oven with temperature control of ± 0.1°C. at 60° with heaters on 4 sides of inner oven.
8. Component ratings according to JAN specs. provides greater assurance of trouble-free operation.
9. Linear carrier shift up to 1000 cycles in the operating range from 2.5 to 6.7 mc.

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DIVERSITY RECEIVERS
LINE AMPLIFIERS
DEMODULATORS
TONE KEYERS

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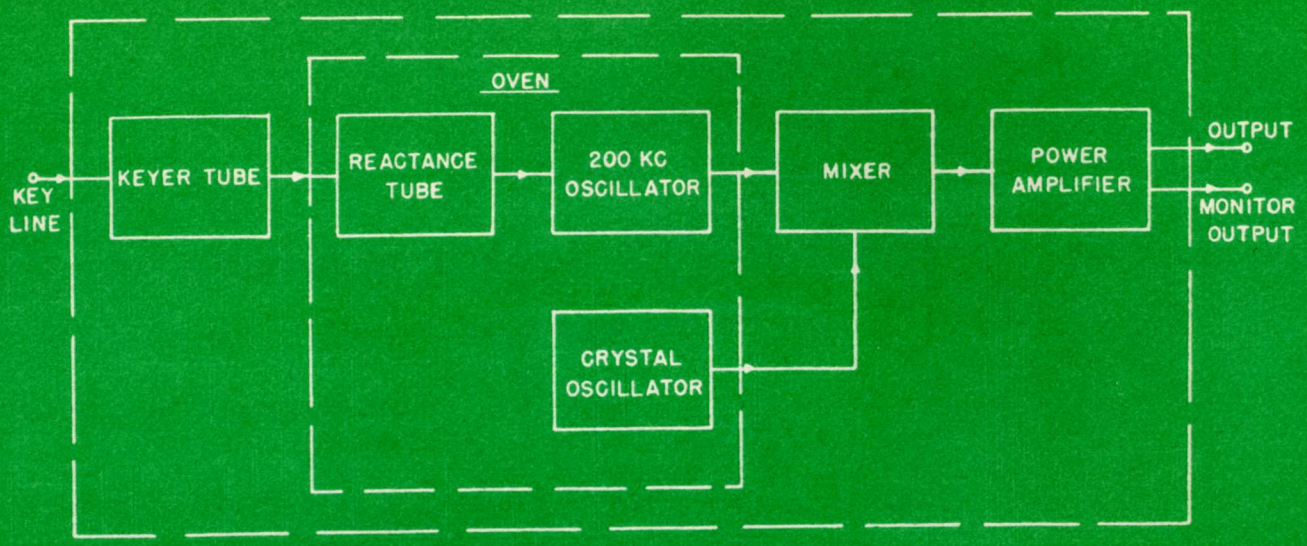

TECHNICAL DATA

NORTHERN RADIO FREQUENCY SHIFT KEYER

Type 105, Model 4

Output Frequency Range: 2.5 to 6.7 megacycles

Frequency Shift: Adjustable from 0 to 1000 cps; this one control adjusts "mark" and "space" frequencies simultaneously and symetrically as mentioned on preceding page

Output Power: 3 watts into 50 to 75 ohms

Monitor Output: 90-120 millivolts across 50 to 75 ohms

Keying Signal: 0 volts for space (lower) frequency and +15 to +150 volts for mark (higher) frequency

Input Impedance: 120,000 ohms, Keying or Fax.

Keying Speed: 150 dot cycles per second

Overall Stability:
1. 10 cps for ambient range from 0°C. to +50°C. (mark and space frequencies)
2. 25 cps for line voltage variation of ± 10% (mark and space frequencies)
3. 2 cps for input signal voltages from +15 volts to +150 volts (mark frequency)

Keying Bias: Not greater than 5.0% at any keying speed up to 150 dot cycles per second

Crystal Frequency: $\frac{\text{Transmitting freq.}}{\text{multiplication factor}}$ —200 kc

Crystal Holder: Similar and equal to Premier PL218 or Bliley MC7—(3 sockets)

Crystal Sockets: 3 crystal sockets are provided with an associated switch

Oven Temperature: 60°C held constant within ±0.1°C

Controls:

Keyer
1. Plate Switch
2. Crystal Selector Switch
3. Test Switch
4. Frequency Adjustment Dial, calibrated in cps
5. Shift Control Dial, calibrated in cps
6. Mixer Tuning Dial, calibrated in mcs
7. Output Tuning Dial, calibrated in mcs

Power Supply
1. Power Switch

Metering:
1. PA plate current indicated by 0-50 ma meter
2. Oven thermometer 58° to 62°C

Power Requirements: Frequency 50/60 cps
Voltage 115 V. ± 10% or 230 V. ± 10%
Power Input at 115 volts
270 watts oven heater on
110 watts oven heater off

Tube Complement:

Keyer

1—6SN7	Crystal Oscillator-Buffer
1—6SN7	Frequency Shift Oscillator
1—6SN7	Reactance Tube
2—6SA7	Modulator Amplifiers
1—2E26	Power Amplifier
1—6SN7	Keying Tube

Power Supply

1—5U4G	High Voltage Rectifier
1—6X5GT	Bias Voltage Rectifier
1—OC3/VR105	Voltage Regulator
1—OA3/VR75	Voltage Regulator

Fuses: (In Power Supply) 1—1.5 A. 250 V. 3AG Size, Keyer fuse
1—2 A. 250 V. 3AG Size, "Oven heat" fuse

Net weight: Power Supply: approx. 23 lbs.
Keyer: approx. 35 lbs.

Shipping Weight: Complete Unit: approx. 88 lbs.

Dimensions: Power Supply: 5¼" high, 19" wide, 9" deep
Keyer: 10½" high, 19" wide, 11" deep

Mounting: 19" relay rack

Auxiliaries: One inter-connecting cable six feet long with spade type lugs. One primary power cord.

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TYPE 115
MODEL 1

NORTHERN RADIO

VARIABLE MASTER OSCILLATOR

PURPOSE: Designed principally for use in diversity reception to supply local common oscillator injection voltage to the receiver. Its variable frequency is designed to give stability equivalent to that obtained by non-temperature controlled crystal oscillators. It is also provided with crystal controlled oscillator for operation of diversity receivers where fixed frequencies are required. This unit may also be used as a transmitter exciter or for laboratory measuring purposes. The entire unit is adequately shielded to eliminate interference with adjacent receiving systems.

DESCRIPTION: The Type 115 Model 1 Oscillator consists of a high frequency variable oscillator, covering the range of 2 to 4 mc, followed by buffers and multipliers to provide output from 2 to 32 mc.

A low frequency crystal oscillator provides for receiver BFO operation.

The output levels of each oscillator can be adjusted to suit any usual requirement.

Three coaxial connectors for each of the RF and IF oscillators are provided.

Local 100 KC crystal is provided for spot calibration of variable HF oscillator.

A crystal oscillator is provided to cover the range of 2-4 mc, and is switched in, in place of the variable oscillator, by a front panel switch to provide choice of 3 fixed frequencies in the 2-32 mc range.

MONITORS
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DIVERSITY RECEIVERS
LINE AMPLIFIERS
DEMODULATORS
TONE KEYERS

TECHNICAL DATA

NORTHERN RADIO VARIABLE MASTER OSCILLATOR

Type 115, Model 1

HF OSCILLATOR

Variable HFO output frequency: 2-32 Mc. continuous

Crystal Frequencies: 2-4 Mc. for output frequencies of 2-32 Mc.

Crystal Holders: Premier type PL218 (3 crystals) 1/8" pin 3/4" center-center

Output Impedance: 75 ohm coaxial

Output Level: 2 Watts 2-4 Mc. 0.5 watt 4-32 Mc.

Output Voltage: Sinusoidal for all output frequencies.

Output Connection: Amphenol Female 83-IR Coaxial (3)

BF OSCILLATOR

Frequency Range: 450-475 KC

Crystal Holders: Premier PL218 (2 crystals)

Output Level: 3.5 volts across 1000 ohms, level control on rear of chassis

Output Connections: Amphenol Female 83-1R (3) coaxial

Controls:

1. Primary power switch
2. HFO on-offswitch
3. HFO crystal-MO switch
4. HFO crystal frequency adjustment
5. Frequency Range switch
6. Output frequency control
7. Calibrator on-off switch
8. Output tuning
9. Meter selector switch
10. BFO on-off switch
11. HFO output level control

Rear Chassis:

1. BFO crystal selector
2. BFO output level control

Primary Power: 110/220 volts 50/60 cycles (approximately200 watts)

Mounting: Standard 19"rack

Dimensions: 19" wide x 10½" high x 14" deep

Weight: Net 54 lbs.

Tube Complement:

1—12AU7	HF Crystal Oscillator and buffer
1—6C4	HFO oscillator
3—6AQ5	Frequency multipliers
1—6AQ5	HF buffer amplifier
1—OA2	Voltage regulator
1—5Y3GT	Rectifier
1—12AU7	BFO and buffer
1—6BE6	Calibrator
1—6C4	Variable Oscillator Buffer
1—6C4	Calibrator output amplifier

HFO Calibration: HFO Variable Oscillator calibration check against 100 KC oscillator

STABILITY

Frequency stability of HF variable oscillator: ±20 cps/mc for ambient change of +25 or —25 (from 0° to 50° C.) for any 8 hour period

5 cps/mc ± 10% line voltage change.

Effect of tube changes: 50 cps/mc average
150 cps/mc maximum

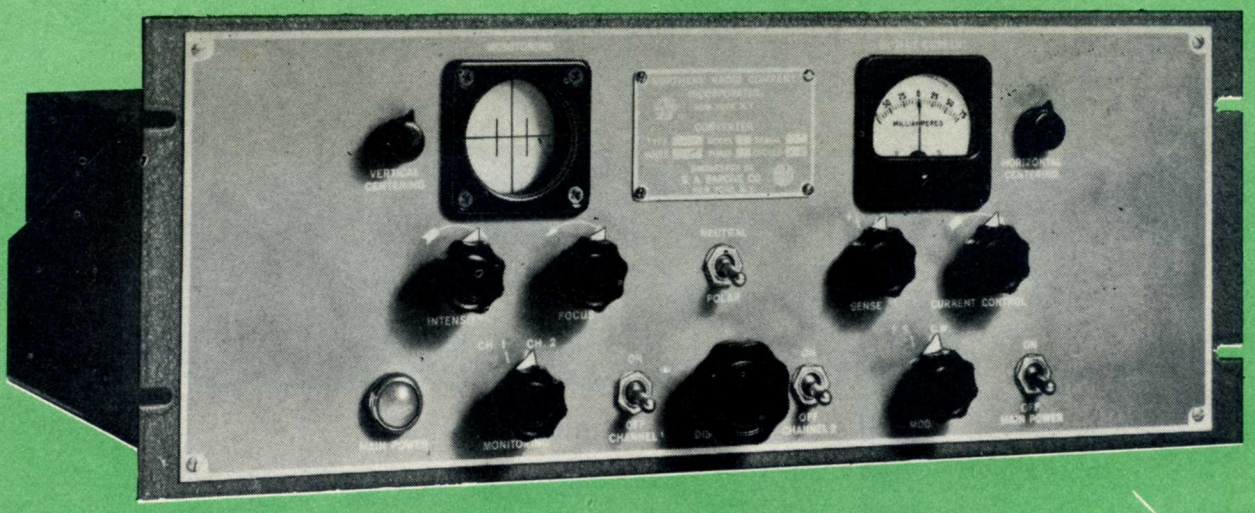
Resettability 20 cps/mc to previously calibrated frequency

Readability: 20 cps/mc

Calibration: Calibration curves provided have readability within 50 cps/mc

Calibration check: A built in, high stability, 0.1 mc crystal provides check points for HFO calibration

Metering: Plate currents and output levels by 2½" square meter. Oven temperature read on mercury column thermostat.



TYPE 107
MODEL 2

NORTHERN RADIO

FREQUENCY SHIFT CONVERTER

PURPOSE: The Northern Radio Company Frequency Shift Converter Type 107 Model 2 is used in radio-teleprinter frequency shift receiving systems to convert the mark and space tones from the output of two diversity receivers into DC pulses capable of operating a teletypewriter, tape recorder or any device requiring DC pulses. The unit may also be used for reception of make and break CW signals.

DESCRIPTION: The Type 107 Model 2 Converter is a dual channel unit for use with dual diversity or single receiver systems. In each channel the received audio tones are limited, amplified, discriminated and rectified. The channels are then diversity combined, and the resultant is fed into push-pull DC amplifiers. The DC output is either polar or neutral, as desired.

Foremost among the many features of this equipment is its ease of operation. Some of the other features are as follows:

a. Two limiter tubes provide between 50 to 60 db of limiting in each channel.

b. The 2" oscilloscope pattern permits tuning the receiver and converter for maximum performance, either in stand-by, *or while keying,* in a matter of seconds.

c. Tone amplification after discrimination permits high level discriminator rectifier output with corresponding improvement in signal-to-noise performance.

d. The high level DC pulse signals are limited so that drift or variations of shift of the incoming signal can be tolerated to a considerable degree.

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DEMODULATORS
TONE KEYERS

TECHNICAL DATA

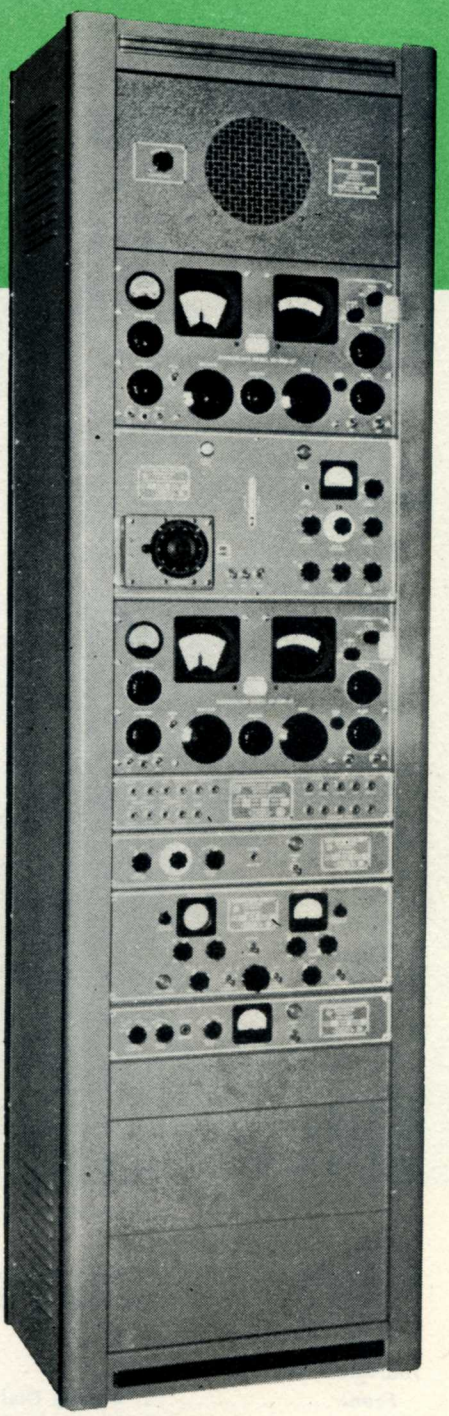
NORTHERN RADIO FREQUENCY SHIFT CONVERTER

Type 107, Model 2

Input Impedance:	600 ohms
Input Level:	—20 to +30 VU (0 VU equals 1 mw)
Input Frequency Shift Limits:	100 to 1000 cps frequency shift.
Output:	1. Polar DC pulses of 60 ma in 1800 ohm external load; one side grounded. 2. Neutral DC pulses of plus or minus 30 ma in 1800 ohm load; center grounded. 3. May be operated into any impedance from 100 to 100,000 ohms.
Keying Speed:	Up to 600 words-per-minute.
Tuning Indicator:	Two inch cathode ray tube.
Metering:	Load current metered on zero center milliammeter
Controls:	Front Panel: 1. Primary power switch 2. Sense switch 3. Monitoring switch 4. Monitor Intensity 5. Monitor Focus 6. Discriminator Tuning 7. Channel #1 On/Off switch 8. Channel #2 On/Off switch 9. Polar-Neutral switch 10. Output current control 11. FS-CW switch 12. Monitor Centering Controls. Rear of Chassis: 1. Load current reverse switch 2. Keying Speed Switch
Power Requirements:	110/220 volts, plus or minus 20% 50/60 cycles.
Mounting:	Standard 19" WE relay rack
Mounting Space:	19" wide x 7" high x 15" deep
Weight:	Approximately 50 pounds.
Tube Complement:	2—6SN7 Tone Amplifiers 2—6SL7GT Limiter Amplifiers 4—6H6GT/G Discriminator Rectifiers 4—5W4 or 5Y3GT Power Supply Rectifiers 1—2AP1-A Tuning Indicator 2—6SL7 DC Amplifiers 2—6L6 Output Amplifiers 1—6H6 Monitoring Rectifier

NORTHERN RADIO

DUAL DIVERSITY RECEIVER



TYPE 110, MODEL 5

The basic Type 110 Model 5 Receiver is an integral assembly of the following equipment:

1. Two Specially designed Receivers with self-contained power supplies, Type 159.
2. One Master Crystal Oscillator, Type 108.
3. One IF monitoring panel, Type 111.
4. One Modulation Selector Panel, Type 112.

To the foregoing may be added, depending upon the service:

5. One Frequency Shift Converter, Type 107.

and/or

6. One Demodulator Unit, Type 104.

and/or

7. One Tone Keyer, Type 102.

The Master Crystal Oscillator Type 108 may be replaced by a Variable Master Oscillator Type 115.

The high frequency and beat frequency oscillators of each receiver are supplied by the Master Oscillator so that reliable operation is secured without the necessity of periodic retuning of these units. This feature is particularly useful when conditions warrant the use of crystal filters in the receiving units, or when frequency-shift signals are received. Provision is made to operate the receiver units separately with their self-contained variable oscillators in a conventional manner where diversity reception is not desired.

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FREQUENCY SHIFT KEYERS
DIVERSITY RECEIVERS
LINE AMPLIFIERS
DEMODULATORS
TONE KEYERS

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TECHNICAL DATA

(RECEIVER ONLY)

NORTHERN RADIO DUAL DIVERSITY RECEIVER

Type 110, Model 5,

Frequency Range: 540 kilocycles to 54.0 megacycles in six bands.

Band 1	.54 to 1.35 mc
Band 2	1.35 to 3.45 mc
Band 3	3.45 to 7.40 mc
Band 4	7.40 to 14.8 mc
Band 5	14.80 to 29.7 mc
Band 6	29.70 to 54.0 mc

Output:

Max. Undistorted Output: Approximately 2.5 watts.

Impedance: 600 ohms balanced, split winding.

Phone Jack winding: Delivers 15 milliwatts into an 8000 ohm resistive load, when the audio output to the 600 ohm power load is adjusted to 500 milliwatts.

Performance:

(Approx. values)

Sensitivity: 2.3 microvolts or better, throughout entire frequency range, for a signal to noise power ratio of 10:1.

Image Rejection Ratio: Better than 80 db. throughout entire frequency range.

I.F. Rejection Ratio: 2700 to 1 at 600 KC.

AVC Action: Will maintain output constant within 12 db. when input is increased from 2 to 200,000 microvolts.

Dimensions: 19″ relay rack cabinet (84″ high x 25″ wide x 18″ deep)

Individual Receiver Controls:

Front:
1. Tuning Dial
2. Tuning Lock
3. Tuning Meter
4. Band Change
5. Selectivity Switch
6. Phasing Control
7. Beat Frequency Oscillator
8. Noise Limiter Switch
9. Send-Receive Switch
10. AVC-Manual Switch
11. R.F. Gain Control
12. Audio Gain Control
13. HFO Local-External Switch
14. AVC External-Internal BFO

Rear:
15. AVC Local-Diversity Switch
16. 3.5 MC Oscillator Switch
17. I.F. Gain Control

Power Requirements: 110/220 volts, 50/60 cycles, approximately 500 watts.

Individual Receiver Tube Complement:

V1	6BA6	1st RF Amplifier
V2	6BA6	2nd RF Amplifier
V4	6J6	High Frequency Oscillator
V5	6BE6	1st Mixer
V6	6BE6	2nd Detector
V7	6BA6	Gate
V8	12AU7	3.5 MC Oscillator
V9	6BA6	1st IF Amplifier
V10	6BA6	2nd IF Amplifier
V11	6BA6	Driver
V12	6BA6	Buffer
V13	6J6	Beat Frequency Oscillator
V14	6AL5	2nd Detector and AVC
V15	6AL5	Limiter & Output Meter
V16	12AU7	Cathode Follower & Audio Amplifier
V17	6V6/GT	Output
V18	OA2	Voltage Regulator
V19	5R4GY	Rectifier
V20	6AL5	C-Rectifier

For data on other units, see individual specifications

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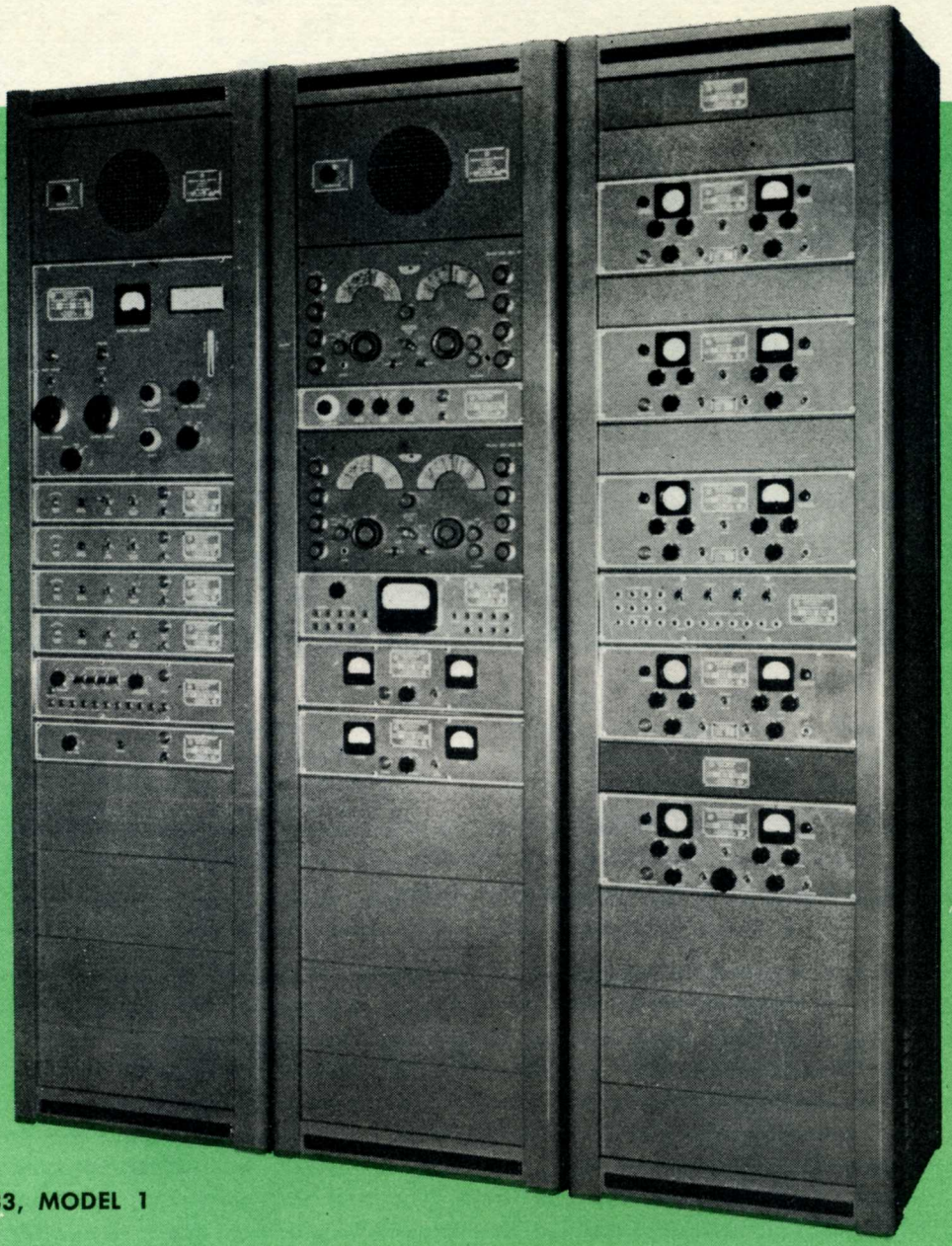

TYPE 133, MODEL 1

NORTHERN RADIO

MULTIPLEX SYSTEM

- MONITORS
- TONE FILTERS
- MASTER OSCILLATORS
- RADIO MULTIPLEX SYSTEMS
- FREQUENCY SHIFT CONVERTERS
- MULTI-CHANNEL TONE SYSTEMS
- FREQUENCY SHIFT KEYERS
- DIVERSITY RECEIVERS
- LINE AMPLIFIERS
- DEMODULATORS
- TONE KEYERS

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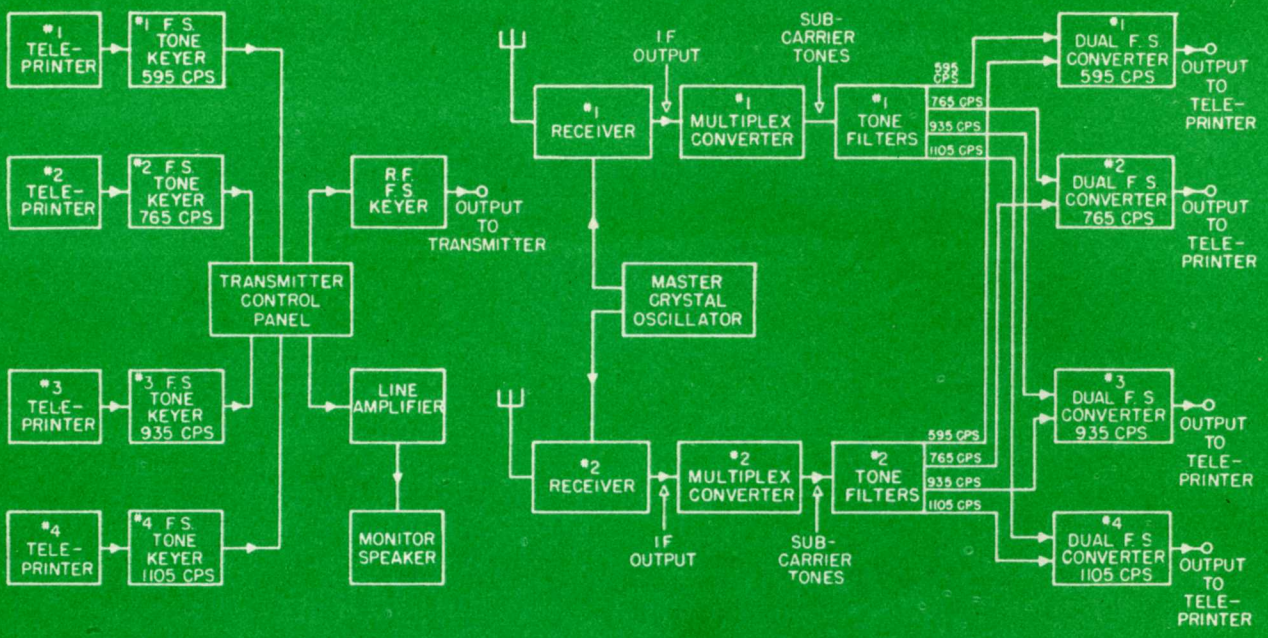


RADIO MULTIPLEX SYSTEM

PURPOSE: The Type 133 Model 1 Multiplex System is principally used for transmitting and receiving radio teleprinter, telegraph, or other similar low speed keying intelligence, where a limited, assigned carrier bandwidth may be utilized for a total of four channels.

This Multiplex System is primarily designed to take advantage of periods of time when propogation conditions give signals which are better than the minimum required for one channel of normal frequency shift operation. As these conditions become apparent, simple operations of key switches will insert as many more channels as the conditions allow. For four channel operation, the system is designed to operate at a minimum bandwidth of approximately 2.5 KC, with provisions for easily increasing the bandwidth to any reasonable value. The System will provide four channel operation when propogation conditions warrant, and when more than the minimum bandwidth can be used, multi-channel may be used under correspondingly less favorable conditions. The operating bandwidth is set by a master control, and the switches at the transmitter and receiver control panels cut the various channels in or out and automatically maintain the bandwidth regardless of the number of channels in use. This feature serves to take full advantage of the available bandwidth at all times so that when conditions require dropping a channel, the remaining ones are proportionately improved. The System also provides switching to standard 850 cycle Frequency Shift operation when desired. However, experience indicates that when propogation conditions will permit frequency shift operation, they will usually permit at least two channels of Multiplex.

DESCRIPTION: The Type 133 Model 1 Radio Multiplex System is based on the principle of frequency modulation of four different audio frequencies. These are added together into a composite signal and made to linearly frequency modulate the carrier. The amount of carrier modulation is adjusted to accommodate the bandwidth required to be transmitted. The relationship of bandwidth and frequency deviation of the carrier is well known and can be evaluated for the usual operating conditions.

The carrier is received on two receivers operating in dual diversity by using properly spaced directive antennae. As in any other good receiving system, the use of spaced directive antennae cannot be over-emphasized in order to reduce the various types of fading. The receivers used are designed to receive high frequency injection voltage from a common crystal oscillator coupled into the receivers by low impedance (75 ohm) coaxial cables. This oscillator is also provided with BFO crystal oscillator for use on standard F. S. operation. Each receiver I.F. system is coupled into an individual multiplex converter consisting of limiters, linear discriminator and tone amplifier. The output of each multiplex converter will contain the original transmitted composite four tones. These are passed through band pass filters and separated into their individual frequency modulated tones. The pairs (one from each diversity chain) of the same tone frequencies are detected and combined in dual diversity in the Tone Converter, Type 107 Model 3 and each of the four converter outputs connected to the individual teleprinters or other printing devices as required.

The Type 133 Model 1 Radio Multiplex System consists of one transmitting rack and two receiving racks:

The Transmitting rack contains:

One Loud Speaker Panel, Type 113 Model 1
One Frequency Shift Keyer, Type 105 Model 3
Four Tone Keyers, Type 102 Model 4
One Transmitter Control Panel, Type 130 Model 1
One Line Amplifier, Type 103 Model 1

The four Tone Keyers are used at different tone channel frequencies and keyed with four different intelligences. The tone frequencies used are 595, 765, 935 and 1105 cps. The outputs of the Keyers are connected in parallel and the composite signal is coupled through a suitable control panel to modulate the F. S. Keyer. The output of the Keyer is used to excite any suitably powered CW transmitter and antenna system.

At the receiving site, two racks constitute a dual diversity multiplex system and contain the following equipment:

Receiving Rack:
One Speaker Panel, Type 113 Model 1
Two (Multiplex) Receivers, Type 141 Model 1
One Master Crystal Oscillator, Type 108 Model 1
One Receiver Patch Panel, Type 128 Model 1
Two Multiplex Converters, Type 121 Model 2

Multiplex Rack:
One Frequency Shift Converter, Type 107 Model 2
Four Frequency Shift Converters, Type 107 Model 3
Two Tone Filters, Type STF Model 2
One Multiplex Patch Panel, Type 129 Model 1

The receiving system can be connected so as to operate in dual diversity for any of the various modes of modulation (i.e. telephone, telegraph, frequency shift, etc.) on a single channel basis; however, its primary purpose is to operate as a multi-channel system.

TECHNICAL DATA

Transmitter Rack

Type of Keying Signals:	Relay contacts closing to ground (Other methods available on request).
Keying Speed:	60 wpm each channel
Output Frequency Range — F.S. Keyer:	2.4 to 6.5 mcs
Frequency Shift—F.S. Keyer:	Linear up to ± 6000 cps at F. S. Keyer output
RF Output Power:	Adjustable to 2 watts
RF Output Impedance:	75 ohms (coaxial)
RF Stability:	Better than plus or minus 80 cps for 50° C. temperature change; better than 80 cps for 10% line voltage change
Sub-Carrier Tones:	595, 765, 935, 1105 cps
Sub-Carrier Shift:	80 cps
Sub-Carrier Tone Stability:	0.5%

Size: ..... All equipment is installed in a closed relay rack 22" wide x 18" deep x 83" high

Primary Power: ..... 110/220 volts 50/60 cps

Tube Complement: ..... For complete list of tubes, see individual instruction book for each equipment.

RECEIVING RACK

Frequency Range: ..... 540 KC to 31 mcs in four bands. For multiplex 2.4 to 31 mcs. Other bands available on special models.

RF Input to Antenna Terminals: ..... 100 to 300 ohms, balanced or unbalanced

Sensitivity: ..... 2 microvolts for signal to noise ratio of 6/1.

Selectivity: .....
a. Narrow — 6 db down at ± 100 cps (With Xtal filter)
b. Medium — 6 db down at ± 4 KC
c. Broad — 6 db down at ± 8 KC

Output: .....
1. For multiplex use, two audio outputs are available, each 3 watts maximum, 600 ohms balanced or unbalanced. The audio voltages are the frequency shifted tones originating at the transmitter and super-imposed on each other.
2. For normal dual diversity use the usual receiver outputs are available:
   a. Audio output either separate or diversity combined at the second detector; 600 ohms balanced or unbalanced.
   b. Second detector outputs, either separate or common.

Metering: .....
1. Audio level meter
2. AVC "S" meter
3. Limiter grid current
4. Discriminator zero center, tuning meter

Primary Power: ..... 110/220 volts 50/60 cps

Size: ..... 22" wide x 18" deep x 83" high

MULTIPLEX RACK

Input Frequencies: ..... Two inputs, each containing composited channels of 595, 765, 935 and 1105 cps

Input Impedance: ..... Two inputs, each of 600 ohms unbalanced

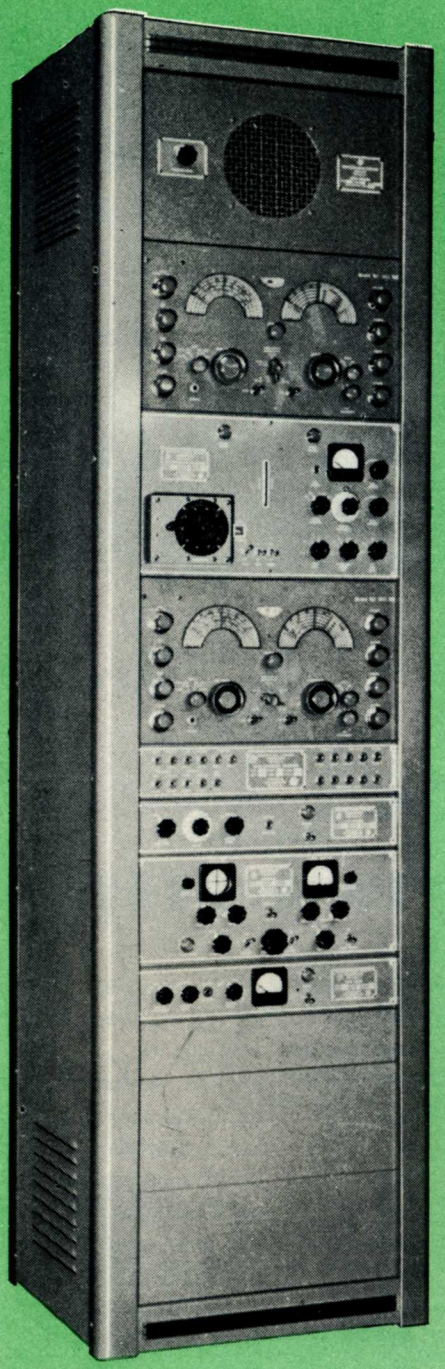
Outputs: ..... Four outputs, each capable of driving a teleprinter in the following modes:
1. Polar DC pulses ± 30 ma into 1800 ohm load
2. Neutral DC pulses of 60 ma in 1800 ohm load
3. Polar or Neutral DC pulses into any impedance within 100—100,000 ohms

In addition to the four multiplex teleprinter outputs, an additional teleprinter output for standard F.S. signal is available.

Metering: ..... Teleprinter output current meter
Cathode ray oscillographic indicator for signal condition in each channel

Primary Power: ..... 110/220 volts 50/60 cps

Size: ..... 22" wide x 18" deep x 83" high



TYPE 110, MODEL 3

NORTHERN RADIO

DUAL DIVERSITY RECEIVER

The basic Type 110 Model 3 Receiver is an integral assembly of the following equipment:

1. Two Specially designed Receivers with self-contained power supplies, Type 141.
2. One Master Crystal Oscillator, Type 108.
3. One IF monitoring panel, Type 111.
4. One Modulation Selector Panel, Type 112.

To the foregoing may be added, depending upon the service:

5. One Frequency Shift Converter, Type 107.

and/or

6. One Demodulator Unit, Type 104.

and/or

7. One Tone Keyer, Type 102.

The Master Crystal Oscillator Type 108 may be replaced by a Variable Master Oscillator Type 115.

The high frequency and beat frequency oscillators of each receiver are supplied by the Master Oscillator so that reliable operation is secured without the necessity of periodic retuning of these units. This feature is particularly useful when conditions warrant the use of crystal filters in the receiving units, or when frequency-shift signals are received. Provision is made to operate the receiver units separately with their self-contained variable oscillators in a conventional manner where diversity reception is not desired.

MONITORS
TONE FILTERS
MASTER OSCILLATORS
RADIO MULTIPLEX SYSTEMS
FREQUENCY SHIFT CONVERTERS
MULTI-CHANNEL TONE SYSTEMS
FREQUENCY SHIFT KEYERS
DIVERSITY RECEIVERS
LINE AMPLIFIERS
DEMODULATORS
TONE KEYERS

TECHNICAL DATA

NORTHERN RADIO DUAL DIVERSITY RECEIVER

Type 110, Model 3

Provision is also made for cross AVC action so that the receiver carrying the lesser signal may be muted. When used with the frequency shift converter, additional diversity advantage is obtained. The converter, being dual channel, limits the receiver signal, amplifies, rectifies and recombines each channel for diversity. DC amplifiers provide pulses for operating a tele-printer and for keying a tone keyer.

Frequency Range: ..... 540 kilocycles to 31 megacycles in 4 bands.

RF Input Impedance: ..... 100 to 300 ohm balanced

Sensitivity: ..... 2 microvolts for signal/noise of 6:1

Selectivity: ..... (a) Narrow: 6 db down at ± 100 cycles (with crystal filter)

(b) Medium: 6 db down at ± 3.5 kilocycles

(c) Broad: 6 db down at ± 8 kilocycles

Audio Fidelity: ..... ± 3 db for 50 to 8000 cps (broad IF)

Output: (with associated equipment) Neutral or Polar DC pulses, tone etc.

Output Level: ..... 8 watts maximum into 500 ohms

Controls: ..... In addition to the normal controls on the Receivers, the following are added:

1. Diversity-Local AVC switch
2. High Frequency Oscillator (Local- Crystal Switch)
3. AVC fast/slow (also controls Internal-External BFO)
4. Diode Load on-off Link

Primary Power: ..... 110/220 volts 50/60 cycles approximately 500 watts

Dimensions: ..... 19" relay rack cabinet (84" high x 25" wide x 18" deep)

Tube Complement: For each receiver unit. (For tube complement of other units see individual specifications of each).

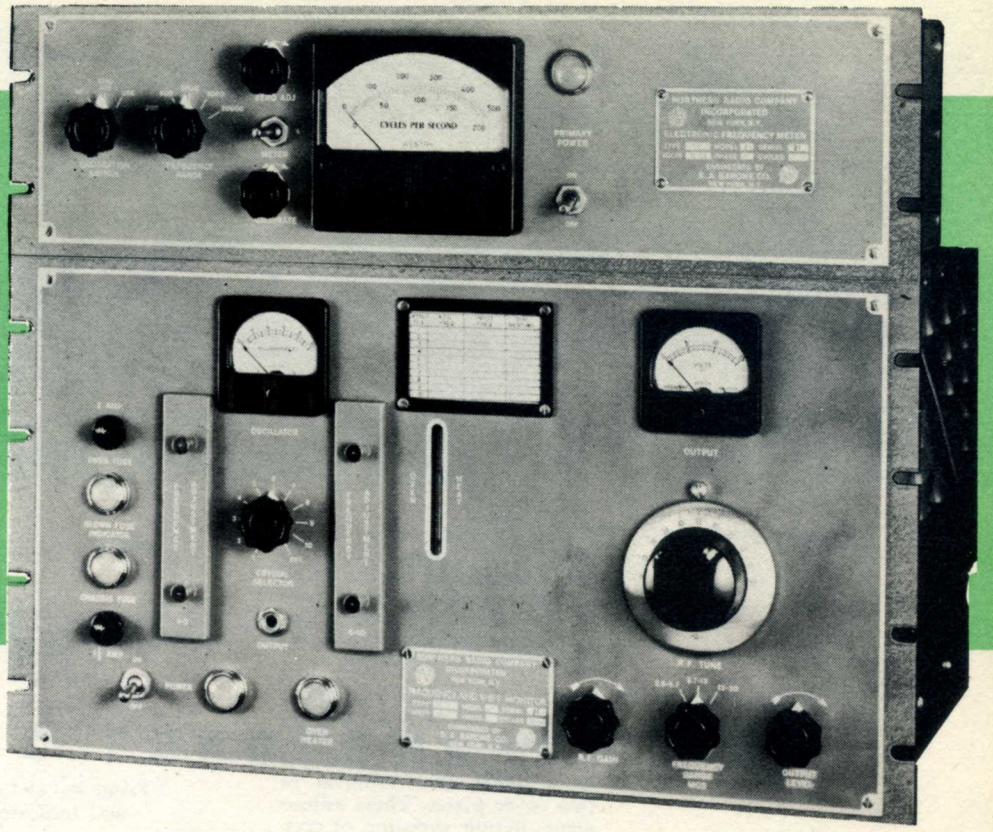
1—6SG7	1st RF Amplifier
1—6SG7	2nd RF Amplifier
1—6SA7	1st Detector
1—6SN7	RF Var. Oscillator
1—6SG7	1st IF Amplifier
1—6SG7	2nd IF Amplifier
1—6SG7	3rd IF Amplifier
1—6H6	2nd Detector & AVC
1—6SJ7	Var. B.F.O.
1—6AC7	AVC Amplifier
1—6H6	Noise Limiter
1—6SJ7	1st Audio Amplifier
1—6J5	Phase Inverter
2—6V6GT/G	Output Amplifier
1—5U4G	Rectifier
1—OD3/VR-150	Voltage Regulator

TRIPLE DIVERSITY RECEIVERS

Triple Diversity Receiver combinations are available and specifications will be supplied on request.

the industry's foremost and complete line of quality communications equipment

TYPE 106, MODEL 4A



NORTHERN RADIO

FREQUENCY AND SHIFT MONITOR SYSTEM

The Frequency and Shift Monitor System, Type 106 Model 4A is comprised of one Frequency and Shift Monitor, Type 106 Model 4,and one Electronic Frequency Meter, Type 127 Model 2.

The following are the specifications for the Type 106 Model 4 Monitor. For information concerning the Electronic Frequency Meter, Type 127 Model 2, consult the Meter's own specification.

PURPOSE: The Type 106 Model 4 Frequency and Shift Monitor is designed as a highly stable secondary standard to measure the frequency of radio transmitters, and also the amount of shift of the output carrier. This becomes particularly useful in measuring the frequency shift of a mark and space signal, either when setting up for traffic or while the transmitter is being keyed with the transmitted intelligence.

DESCRIPTION: The Type 106 Model 4 Frequency and Shift Monitor consists of a highly stable, temperature-controlled crystal oscillator and buffer, with provision for selecting one of ten crystals, or an external oscillator. Wide band amplifiers bring the oscillator output to a level suitable to drive a harmonic generator. Harmonics of the crystal frequencies are heterodyned with the amplified RF input signal. The difference frequency from the detector is then amplified to the required level.

Ten separate transmitters may be monitored for transmitter carrier frequency and for frequency shift. Additional transmitters may be monitored using external secondary standards. If the crystal frequencies are half-way between the mark and space frequencies, then the carrier frequency can be monitored while keying, by adjusting the transmitter frequency until the average frequency indicated by the Electronic Frequency Meter is constant, and the amount of frequency shift will be twice the frequency read on the meter. This method is particularly useful at low keying speeds such as teleprinter. Carrier frequency monitoring at higher keying speeds should be done aurally with a pair of head phones, by adjusting for single steady tone, and the amount of frequency shift will again be twice the frequency read on the Frequency Meter.

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TECHNICAL DATA

NORTHERN RADIO FREQUENCY AND SHIFT MONITOR SYSTEM

Type 106, Model 4A

Frequency Range: 2.5 to 30 MCS in three ranges:
1. 2.5 to 5.7 MCS
2. 5.7 to 13.0 MCS
3. 13.0 to 30. MCS

Crystal Frequency Range: 1.0 to 6.0 M.C.

Frequency Selection: Eleven Positions: – Ten crystal controlled frequencies with added provisions for use of an external oscillator. Input connection for external oscillator is made with a coaxial chassis receptacle at rear of chassis.

Frequency Adjustment: Separate air dielectric trimmer capacities for each of the ten crystals. Crystal frequency adjustments are made from the front panel after removal of two cover plates. These adjustments permit variation of crystal oscillator ± .002% (40 cycles per M.C.).

Crystal Sockets: Accommodate standard straight pin crystal holders with ¾" spacing such as Bliley MC-7, Reves Hoffman RH-11, or Commercial Radio Equipment Co. DC-11.

Crystal Oven: Accommodates ten crystals. Oven temperature 60° C. nominal.

Oven Temperature Control: Mercury column thermostat operates a relay which controls the oven heater elements. An auxiliary thermostat is employed in the oven to prevent excessive temperature in the event of improper operation of the mercury column thermostat or heater element control relay.

Frequency Stability: Using crystals having a temperature coefficient of three parts per million per degree Centigrade, the frequency variation does not exceed .0002% (2 cycles/MC) for any variation in line voltage from 105 to 130 volts AC, 60 cps, and does not exceed .0002% (2 cycles/MC) over an ambient temperature range of 0 to 50° C. after a 48 hour warm up period at room temperature.

Frequency Shift Range: 10 to 10,000 cps.

R.F. Input Level: 100 millivolts or less required to obtain 2 volts audio output.

R.F. Input Impedance: Two Positions:
1. 50 ohm coaxial line to pick up point on transmitter or frequency shift exciter.
2. High impedance input 470,000 ohms shunted by approximately 20 mmfd.

Audio Output Level: 10 volts audio output capability (Open Circuit) Total harmonic distortion does not exceed 10% with unit adjusted for 2 volts audio output.

Audio Output Impedance: 10,000 ohms ± 20%.

Audio Output Connection: Headset jack on front panel and barrier type screw terminals on rear of chassis.

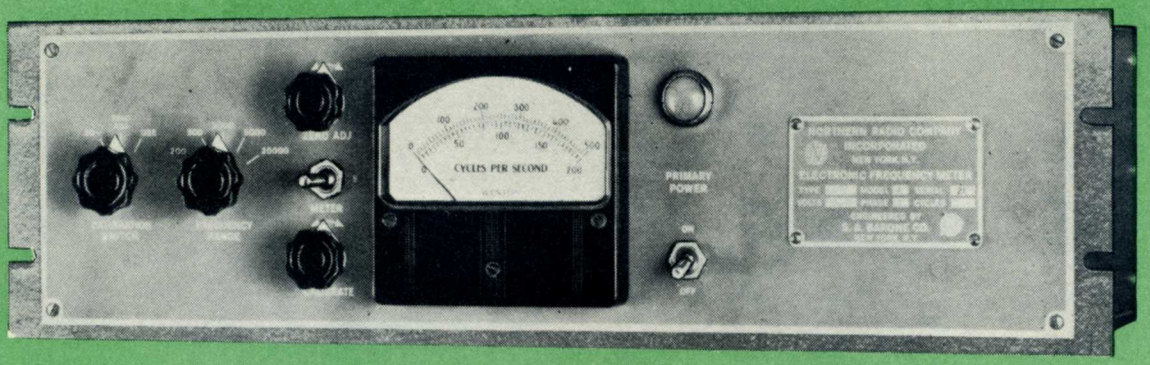
Front Panel Controls and Indicators:
1. Primary Power Switch
2. Frequency Range Switch
3. Crystal Selector Switch
4. R.F. Tune Control
5. Output Level Control
6. R.F. Gain Control
7. Oscillator Plate Current Meter
8. Audio Output Level Meter
9. Oven Thermometer
10. Power "ON" Light (Red Jewel)
11. Crystal Oven Light (Amber Jewel)
12. Oven Fuse
13. Oven Blown Fuse Indicator (Amber Jewel)
14. Chassis Fuse
15. Chassis Blown Fuse Indicator (Amber Jewel)

Power Supply: Self-contained. 115 or 230 volts AC 50/60 cycles, single phase.
Approximately 90 watts with oven heater off.
Approximately 230 watts with oven heaters on.

Mounting: Standard 19" relay rack.

Dimensions: 19" wide x 10½" high x 14" deep.

Tube Complement: 6SN7—Crystal Oscillator and Buffer
6AU6—Wide Band Amplifier
6AQ5—Wide Band Amplifier
6AH6—Frequency Multiplier
6AU6—Input Amplifier
6AH6—R.F. Amplifier
6AL5—Detector
6AQ5—Audio Amplifier
OB2—Voltage Regulator
5Y3GT—Power Supply Rectifier



TYPE 127
MODEL 2

NORTHERN RADIO

ELECTRONIC FREQUENCY METER

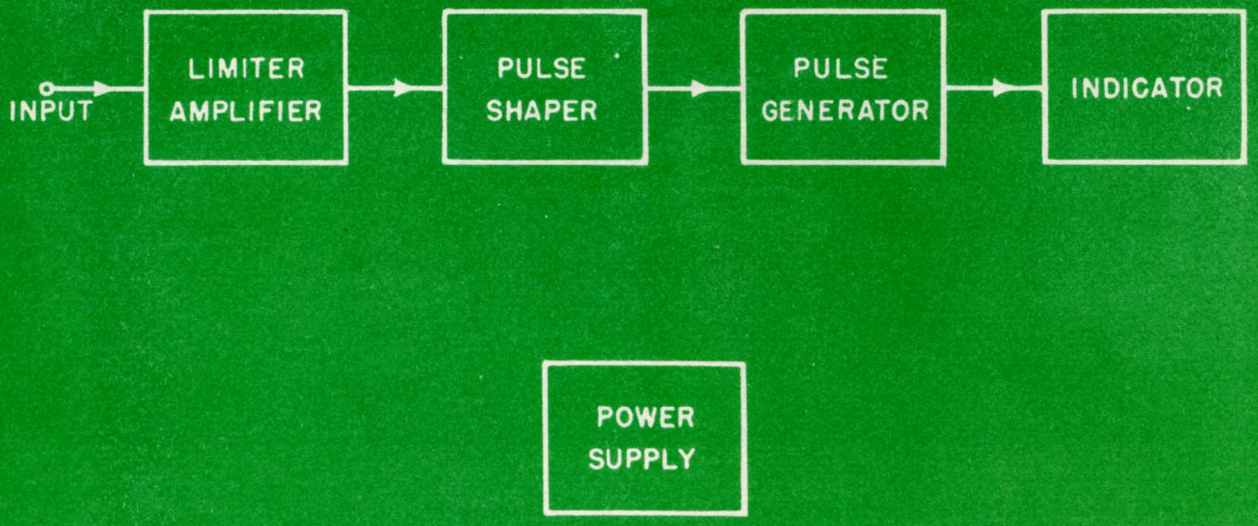
PURPOSE: The Type 127 Model 2 Electronic Frequency Meter is a precision, self-contained instrument used to measure audio frequency independent of amplitude or wave form.

This unit is particularly designed as a companion unit for the Type 106 Frequency and Shift Monitor, and the special features incorporated make it unusually well suited for many laboratory and other measuring applications. Its accuracy is 2% of full scale for the ranges 0-200, 500, 2000, 5000, 20,000 cps. The meter is designed with a normal or a critical damping factor, selected by a front panel switch. When on the fast, or critical damping setting, the meter will follow teleprinter mark to space keying frequencies, so that a transmitter carrier can be adjusted to the center of the mark and space frequencies within a few cycles, when beat against a suitable crystal in a monitor. This feature makes it possible for this unit to be used for monitoring the transmitter RF output carrier frequency and for measuring the amount of frequency shift on the carrier while it is being keyed with teleprinter intelligence. The Frequency and Shift Monitor System Type 106 specification describes this combined feature. This critical damping feature is also useful in many other applications where rapid follow of frequency variations is required.

DESCRIPTION: The Type 127 Model 2 Electronic Frequency Meter incorporates a novel pulse rate counter circuit which can be calibrated to high accuracy. The original calibration is maintained indefinitely, independent of aging of tubes or line voltage changes.

The Frequency Meter consists of a multistage amplitude limiter and pulse shaper; the shaped pulses trip a pulse generator which generates nearly perfect rectangular pulses whose repetition rate is the same as the applied unknown frequency and whose duration is constant for a given range switch setting of the Frequency Meter. The DC component of the generated pulses is, therefore, precisely directly proportional to the pulse repetition rate, permitting the use of a DC meter linearly calibrated in cps.

The Frequency Meter with self-contained power supply is constructed for standard 19-inch relay rack mounting, occupying 5¼ inch panel space.



TECHNICAL DATA

NORTHERN RADIO ELECTRONIC FREQUENCY METER

Type 127, Model 2

Input Level: ..... 1.0 to 100 V.

Input Impedance: ..... 100,000 ohms, one side grounded

Frequency Range: .....
1. 0 — 200 cps
2. 0 — 500 cps
3. 0 — 2,000 cps
4. 0 — 5,000 cps
5. 0 — 20,000 cps

Accuracy: ..... ± 2% of full scale for all ranges

Controls: .....
1. Primary power switch
2. Frequency Range switch
3. Zero adjustment
4. Calibration switch
5. Calibration control
6. Meter Fast-Slow switch

Metering: ..... Input frequency indicated by 4" square meter.

Primary Power: ..... 110/220 volts ± 10% 50/60 cps

Dimensions: ..... 5¼" high x 14" deep x 19" wide

Weight: ..... Approx. 23 pounds

Tube Complement: .....

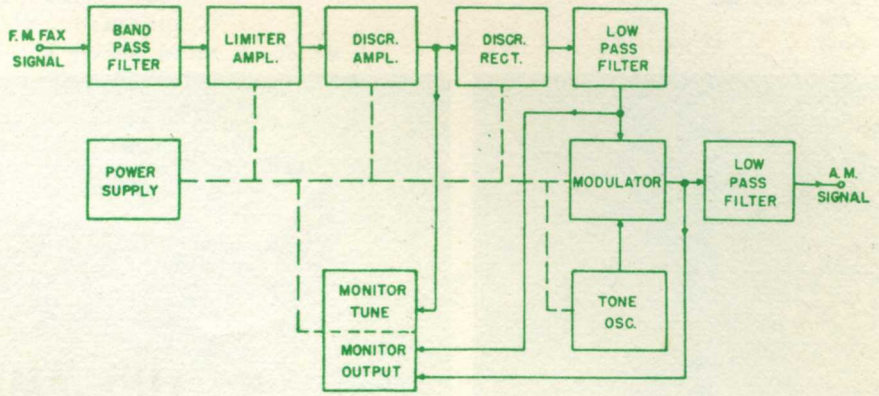
1—6SN7	Limiter Amplifier
1—6SN7	Pulse Shaper & Limiter Amplifier
1—6SN7	Pulse Generator
1—5Y3GT	Rectifier
1—VR75	Voltage Regulator
1—6SH7	Limiter Amplifier
1—6SF5	Reg. Amplifier
1—6Y6G	Reg. Tube
1—12-4	Current regulator

TYPE 125,
MODEL 1

NORTHERN RADIO FACSIMILE CONVERTER

This Converter is used in Radio Facsimile or Telephoto Receiver systems to convert the incoming frequency shift signals into amplitude modulated tones. These modulated tones are applied to photo or Fax recorders requiring this type of input signal.

It is a single channel unit for use with single receiver systems. The frequency modulated tone input is limited, amplified, rectified into pulses and amplitude modulates a tone oscillator. This unit is provided with an oscilloscope tuning monitor which indicates the proper receiver adjustment and a pattern of the image pulse signals.



TECHNICAL DATA

Input Impedance: ..... 600 ohms balanced

Input Level: ..... —10 to +30 VU (0 VU equal 1 MW)

Input Frequency Deviation: ..... ±500 cps centered about 2550 cps

Output Distortion: ..... Converter response is linear within ± 2.5%.

Pix Band Width: ..... 1800 cps approx.

Tuning Indicator: ..... Two inch cathode ray tube

Metering: ..... Output level indication by 2½" square meter.

Controls: .....

1. Primary power switch
2. Monitoring switch
3. Monitoring intensity
4. Monitoring focus
5. Monitoring horizontal centering
6. Monitoring sensitivity
7. Monitoring vertical centering
8. Output level pad
9. Density control

Output: ..... 2000 cps ± 10% tone amplitude modulated by picture signals.

Output Impedance: ..... 600 ohms balanced

Output Level: ..... Adjustable from —45 VU to approximately +10 VU.

Power Requirements: ..... 110/220 volts plus or minus 10% 50/60 cps.

Mounting: ..... Standard 19" WE relay rack

Dimensions: ..... 19" wide x 7" high x 14" deep

Weight: ..... Approximately 40 lbs.

Tube Complement:

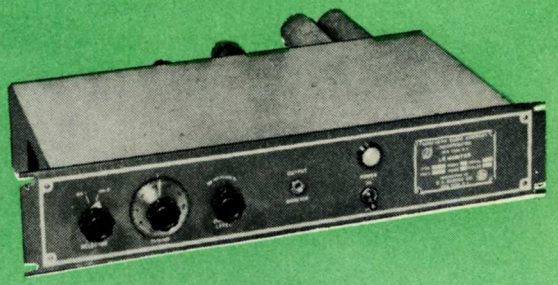
1—6SL7GT	Limiter Amplifier	1—2AP1-A	Monitor
1—6SN7GT	Tone Amplifier	1—6SL7GT	Monitor Amplifier
2—6H6GT/G	Discriminator	2—5Y3GT	Rectifier Power Supply
1—6J5	Tone Oscillator	1—6SL7GT	Monitor Pulse Generator
1—6SN7GT	Tone Mod. P.A.		

MASTER CRYSTAL OSCILLATOR

TYPE 108, MODEL 1

This unit replaces, with common crystal controlled signals, the high frequency and beat frequency oscillators of single or diversity receivers. Any one of four crystals may be selected in the high frequency oscillator, and either of two crystals in the BF oscillator. The high frequency oscillator is followed by a tuned buffer stage, and all outputs from the unit are on low impedance coaxial lines. A front panel control permits varying the output of the HF oscillator at least ± 50 cycles for alignment with the incoming signal.

Output: ..... 75 ohms adjustable to 10 volts.
RF: 2 to 30 megacycles.
IF: 425 to 475 Kc.



INTERMEDIATE FREQUENCY MONITOR

TYPE 111, MODEL 1

The IF Monitor is used with diversity reception to sample the Intermediate Frequeney of each individual receiver. It is particularly useful in tuning each receiver accurately to CW, ICW or phone signals when no receiver BFO is used.

It consists of an IF oscillator which is heterodyned with the sample from the receiver to produce a beat tone. The beat is amplified to headphone level for monitoring purposes.

CHANNEL TONE FILTERS

Channel Tone Filters are designed for use in multi-channel carrier telegraph systems where their function is generally to separate into single frequencies the complex voltage transmitted by the system. They consist of band pass filter networks with a common input and separate outputs, one output for each standard frequency.

Frequency Range: ..... All tone channel frequencies throughout normal audio transmission spectrum.
Keying Speed: ..... Dependent on bandwidth.
Impedance: ..... 600 ohms input and output.
Input Level: ..... Usually +6 db maximum.
Output Level: ..... Usually −4 db for maximum input.

LINE AMPLIFIER

TYPE 103, MODEL 1

A general purpose line amplifier for communications work, featuring flat frequency response, low noise and distortion.

Input and Output Impedance: ..... (600 ohms balanced; 150 ohms unbalanced).
Transmission Gain: ..... 46 VU.
Input Level: ..... For rated output of +23 VU —23 VU to +23 VU.
Distortion: ..... Less than 1% at rated output level.
Noise Level: ..... 80 VU below rated output.
Frequency Response: ..... ± 1 db 100 to 10,000 cps.

TONE KEYER

TYPE 102, MODEL 1

A complete, compact, flexible and versatile tone keyer. Provided with a stable RC oscillator which generates standard tones of 425, 765, 1105, 1445, 1785 and 2125 cps. A balanced output stage provides for various types of keying of any one of the above tones or of an injected external tone.

Keying Input ..... 1. Relay contacts.
2. Amplitude modulated (keyed) tone, 300 to 10,000 cps.
3. DC pulses, positive or negative, polar or neutral.

Input Level ..... 1. Audio — 0 db.
2 DC: ± 10 volts.
3. DC current pulses ± 30 ma polar or 60 ma neutral.

Output Impedance ..... 600 ohms balanced H pad.

Keying Speed ..... up to 1000 words per minute (limited by tone frequency used).

DEMODULATOR

TYPE 104, MODEL 3,

This equipment is used in communication systems where intelligence is transmitted by means of amplitude modulated tones. It converts these tones to DC pulses and its output is capable of operating a teleprinter, tape recorder, or other DC operated device. The unit consists of a tone amplifier driving a full wave rectifier, operating into a pair of DC amplifiers.

Input Tone: ..... Any single amplitude modulated tone (Keyed) between 400 and 10,000 cps.

Input Level: ..... —20 to +30 VU.

Output: ..... 1. Neutral DC pulses of 60 ma in 1800 ohm external load, one side grounded.
2. Polar DC pulses of ± 30 ma in 1800 ohm external load, center grounded.
3. May be operated into any impedance from 100 to 100,000 ohms.

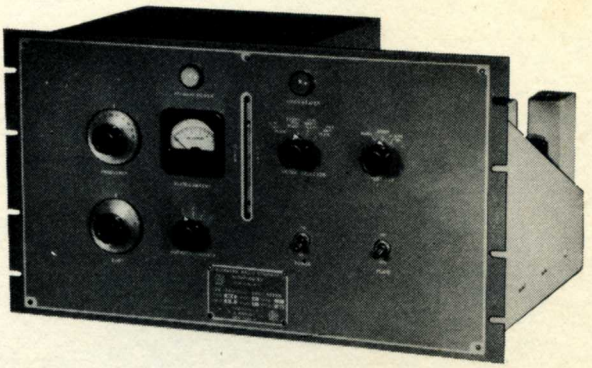
Keying Speed: ..... Up to 600 w.p.m.

LOW FREQUENCY SHIFT KEYER

This equipment was designed to meet the requirements of a simple, flexible, yet highly stable, Frequency Shift Keyer, to operate in the 50 to 500 Kilocycle region. The low output frequencies are derived by first generating a basic 2 MC frequency from a 1.8 MC crystal oscillator, and a 200 KC reactance tube oscillator. The 2 MC basic frequency is heterodyned with a frequency determining crystal oscillator in the range of 2050 to 2500 KC, to produce the output frequency of 50 to 500 KC.

One of the many features of this equipment is the absence of circuit tuning controls. Changing frequency requires simply changing the selector switch to the crystal for the desired frequency. All subsequent circuits are low pass and require no adjustment.

FrequencyShift: ..... 50-650 cps.
Output Power: ..... 2 watts.
Keying Signal: ..... DC pulses 30 to 100 volts polar or neutral, positive or negative.
Keying Speed: ..... 150 w.p.m.



TYPE 109, MODEL 1

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