DESIGNING INTRA-CITY AND INTER-CITY CARS BAND DISTRIBUTION SYSTEMS

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This paper reports the practical applications of an FCC type approved development for Airlink CATV service.

The purpose of this article is to acquaint the industry with the practical applications of systems which have been filed with the FCC by cable operators and to show the economic and technical performance advantages of this new tool for cable television operators for both inter-city and intra-city CARS Band Distribution.

TWO-WAY MICROWAVE COMMUNICATION

It should be understood that Airlink CATV has two-way communications capabilities. Therefore the first system to be described will be one which we have in the design stage, shown on Figure 1, which we anticipate will be employed on a medical training program involving a medical center with member hospitals. The member hospitals participating will engage in bi-directional, interactive communications.

Figure 1 is a Laser Link System with two-way communications capabilities where the network illustrated shows ten (10) receiving stations, each of which is capable of transmitting back two (2) six megahertz channels in the same band, one of which could be used to provide specialized two-way or party-line communications between the receiving terminals.

In areas of community-wide communications services, specialized functions, such as Fire and Police Department reporting could be multiplexed over the Airlink System to each receiving location from which point it would be transmitted back as composite video to a Laser Link Transmitting Center, where messages could be relayed to Police and Fire Departments. Where such services are localized, each receiving point could serve as a contact with the appropriate local authorities.

THE LASER LINK SYSTEM

In the interest of first understanding the components of an Airlink system, we will review figures 2 to 6. Figure 2 is a block diagram of a cable system employing an air link equipment between the head end and the subscriber distribution system. Figure 3 is the typical configuration of the FCC type approved QLL 12T transmitter mounted on a 4 foot parabolic antenna. Figure 4 is a rear view of the transmitter with the cover removed showing the components. Figure 5 is the typical configuration of the receiver/converter.

Figure 6 is a view of the Laser Link Airlink System transmitter and parabolic antenna atop a tower at the Laser Link Laboratories, Garden City, Long Island, New York.

ACTUAL FCC FILINGS

The typical applications involved in distribution from a head end are:

1. A single head end to deliver multichannel signals to several remote population centers is shown in Figure 7. In this application, three communities at five, six and twenty-one miles will be serviced from an existing head end by three beams from a single transmitter.

2. To get signals over a mountaintop while simultaneously interlinking contiguous areas, the system design of Figure 8 is used. A 6,600 foot mountain hides the receiving site from the head end. This obstacle is overcome by using the mountain peak as a receiving point and simultaneously relaying the signals by means of a passive repeater consisting of two (2) ten foot antennas back to back.

3. The system of Figure 9 is used to economically jump over highways, railroad tressles and waterways. Three (3) sites at 4.6, 9 and 9.7 miles are connected to an existing head end which would otherwise require elaborate, expensive long runs of cable to get under highways and railroads and to go under or around major waterways.

4. Figure 10 shows a layout designed to optimize head end locations while avoiding "dry trunks." In addition to taking the signals from the head end to a new subscriber area, the design provides for future expansion to two additional sites by the addition of an independent amplifier, Type QLL-12TA to the transmitter.

5. In mountainous terrains a single head end on an isolated mountain provides service to many valley communities. The initial configuration provides service to three communities, with growth potential to ten (10) additional locations. One community, because its location is obscured by the terrain is reached by means of an active repeater operating at the intermediary receiving point. (Fig. 11)

6. Airlinks provide the capability to minimize underground distribution in urban areas. Since the subscriber populations are separated by non-revenue producing sections, the underground trunking costs are greatly reduced by the Airlink from the head end to each subscriber center. (Figure 12)

7. Figure 13 is an unusual application where we are taking an existing head end and beaming service to three additional cities, two via directional parabolic antennas line of sight to receiver/converter locations within twenty-five miles; and the third community serviced via a parabolic antenna from head end to a passive reflector on a mountain ridge, and thence deflecting the

signal to a receiver/converter six miles distant. Neighborhood service via input terminals at each localized Laser Link receiver/ converter location are a standard capability to make available local community organizations.

This paper will describe systems which have been filed with the FCC which are in the seven categories listed above. It should be understood that in every instance where the Airlink has been applied there is a great economic savings as well as a technical improvement in system performance. Comparisons of typical configurations are shown on Table I. It should be noted by referring to the chart, (Table I), that even a single hop of eighteen miles has comparable signal to noise ratio (S/N) as a high performance cable trunk and we are comparing a $60,000.00 investment for Airlink against $230,000.00 capital cost for a cable system (not counting the annual pole rental charges). For "Seven Directions", with air distance from head end of twenty-five miles, the signal to noise ratio is comparable even for one (1) inch of rain, but the comparison of cost between Airlink and trunk cable at this distance is astonishing - $125,000.00 as compared to $2,226,000.00

All of these savings are achieved while making an improvement in the performance of the system under average weather condition.

<u>FILING FOR AIRLINK CATV</u>

For systems which are overgrown or where inter-city or intra-city Airlink connections satisfy a cable TV operator's requirements, the procedure for placing this system into service is as follows:

A. The cable operator submits his plan to our field engineering group who report on both the technical and economic advantages of the system as it should be applied to specific requirements and the most economic combination of Airlink and cable.

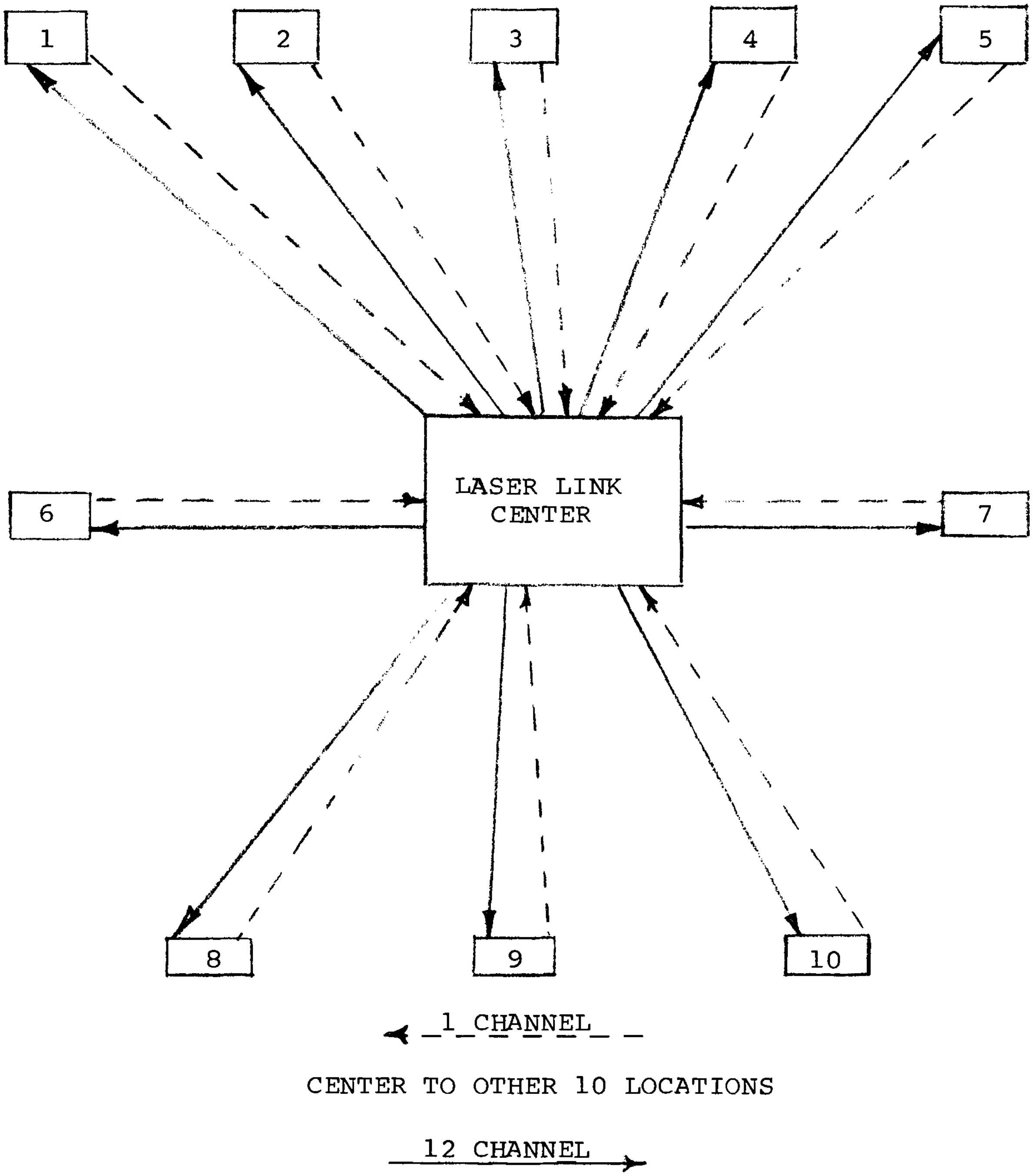
B. The cable operator takes the information received from field engineering and provides the responsive information needed on FCC Form No. 402. On this form, a cable operator is required to show the need for an Airlink service and for use of each channel as well as his planned location for transmitter and receiving sites.

C. Upon accepting the application, the FCC issues a BPCLD Number which acknowledges the suitability of the application for filing. The application is then in line for processing.

D. The FCC studies any possible interference and if all conditions are satisfactory, will issue a construction permit. The application of this system should make the Airlinking of areas with only a few hundred potential subscribers viable and economically sound; open up the urban markets so that the cable operator is not burdened by a leased cable association with the local telephone companies. "Dry trunks", railroad tressles, highways and the burden of obtaining right of way are eliminated to an important extent by the use of Airlink CATV.

The employing of Airlinks opens new markets for cable TV as operators as well as improving the standards in existing over-burdened systems. The equipment in this art has now been Type Accepted and will soon be adaptable for low-cost long haul CARS Band Microwave.

The future is great for those who have the wit and the means to bring new developments like this into early service.



CENTER:
- 1 - QLL 12 Transmitter - 12 TV channels
- 10 - Beams 1 per location
- 10 - Standard Microwave Receivers & Modulators

SATELLITE LOCATIONS:

1 - QLL 12 Receiver - 12 TV channels	Total	10
1 - QLL 12 Receiving Antenna	Total	10
1 - Standard Microwave Transmitter	Total	10

With 11 TV sets at each location all 11 are in continuous communication with everyone else. Possible combinations are:

4 Two Way + 1 Three Way. Up To 11 Party Conference of all locations.

Fig. 1

FIG. 1

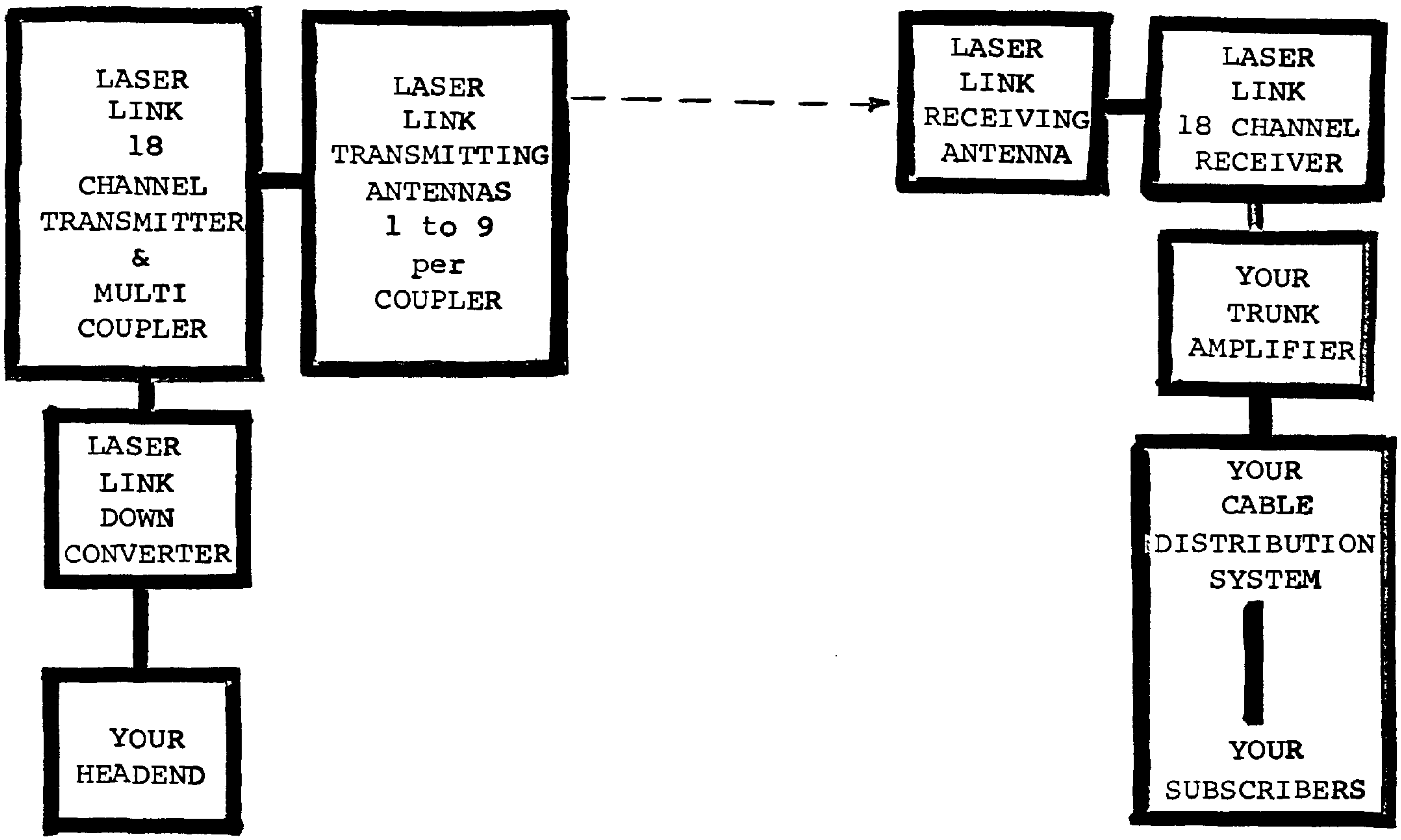

LASER LINK 18 CHANNEL TRANSMITTER & MULTI COUPLER
LASER LINK TRANSMITTING ANTENNAS 1 to 9 per COUPLER
LASER LINK RECEIVING ANTENNA
LASER LINK 18 CHANNEL RECEIVER
LASER LINK DOWN CONVERTER
YOUR HEADEND
YOUR TRUNK AMPLIFIER
YOUR CABLE DISTRIBUTION SYSTEM
YOUR SUBSCRIBERS

FIG. 2

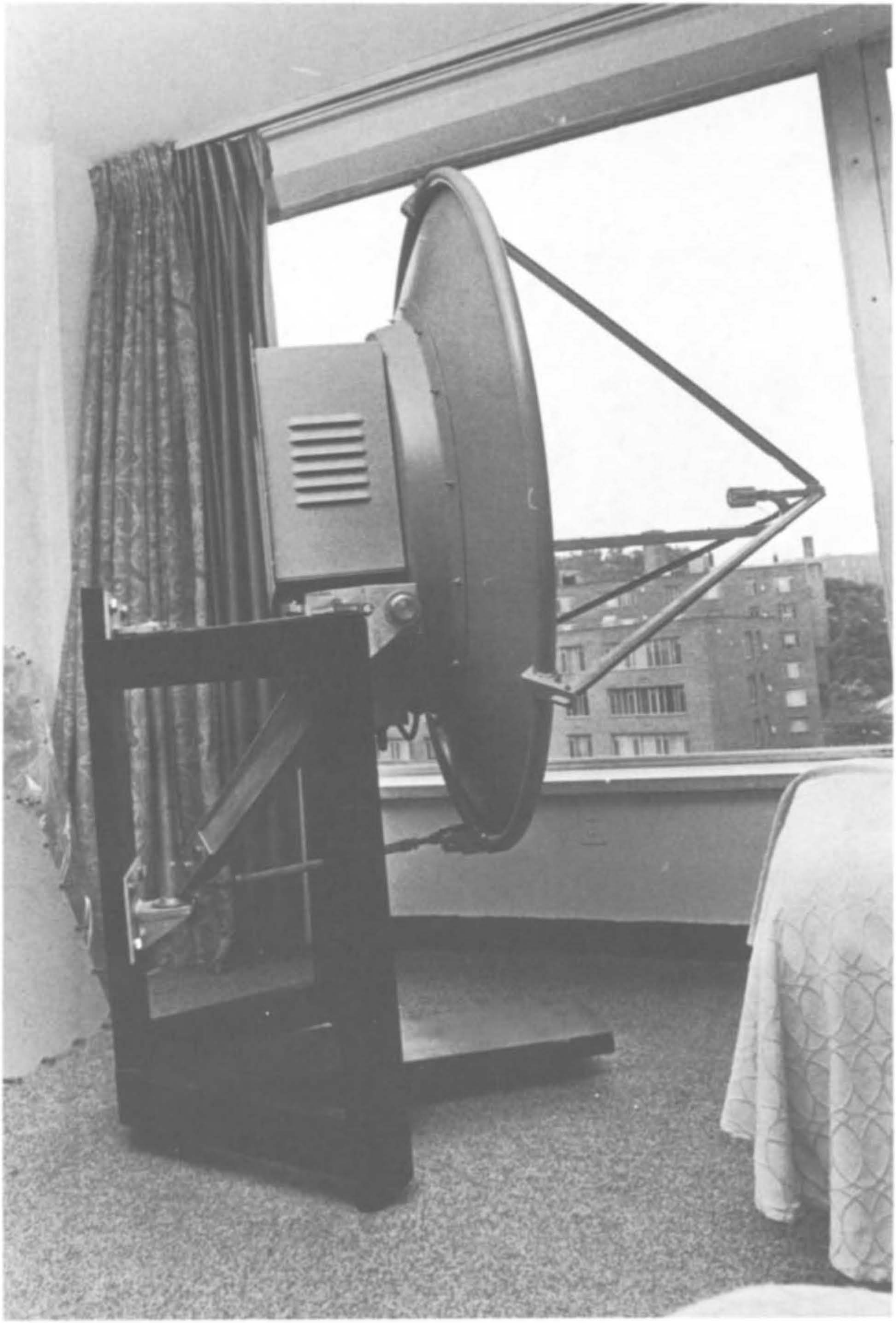


FIG. 3

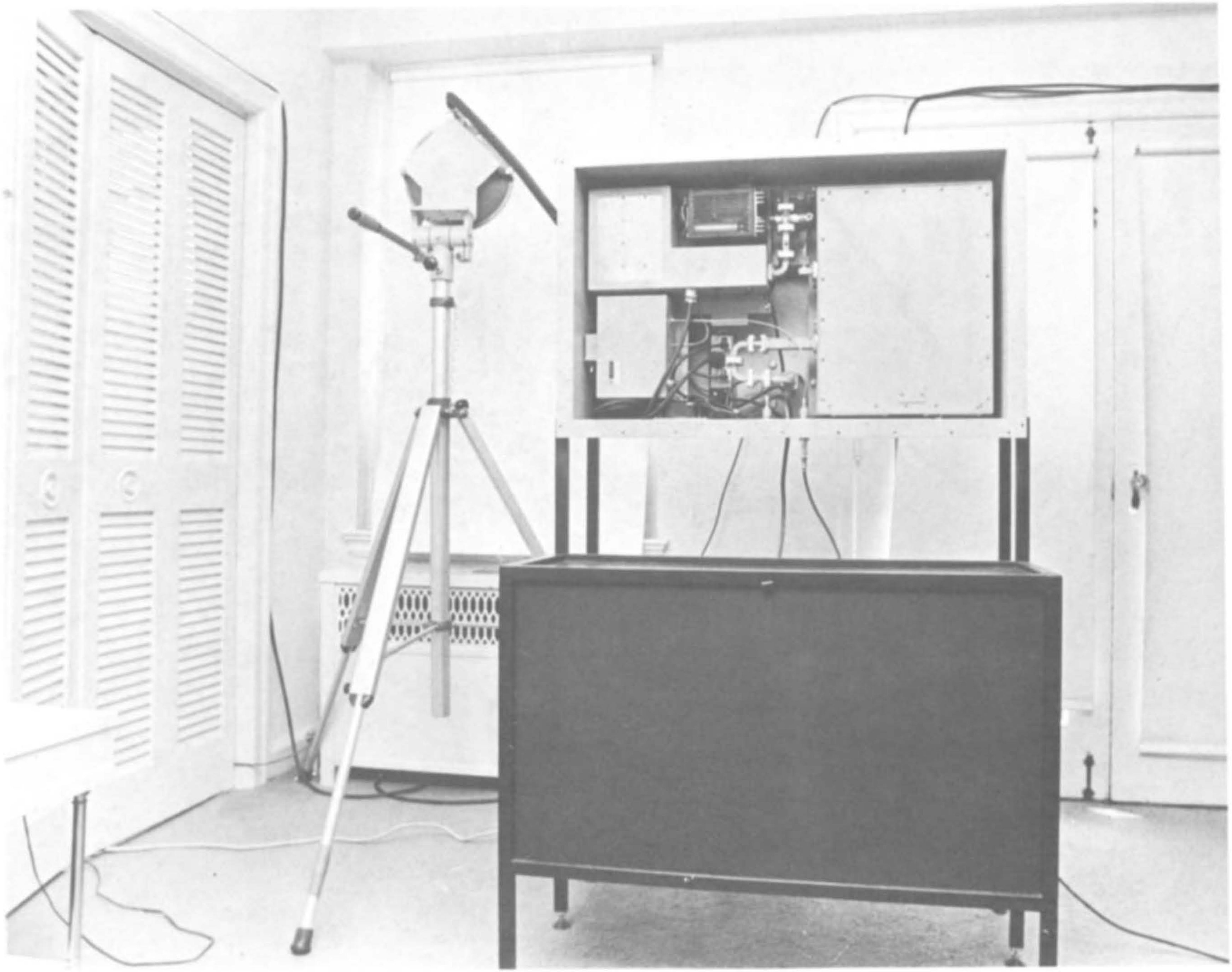


FIG. 4

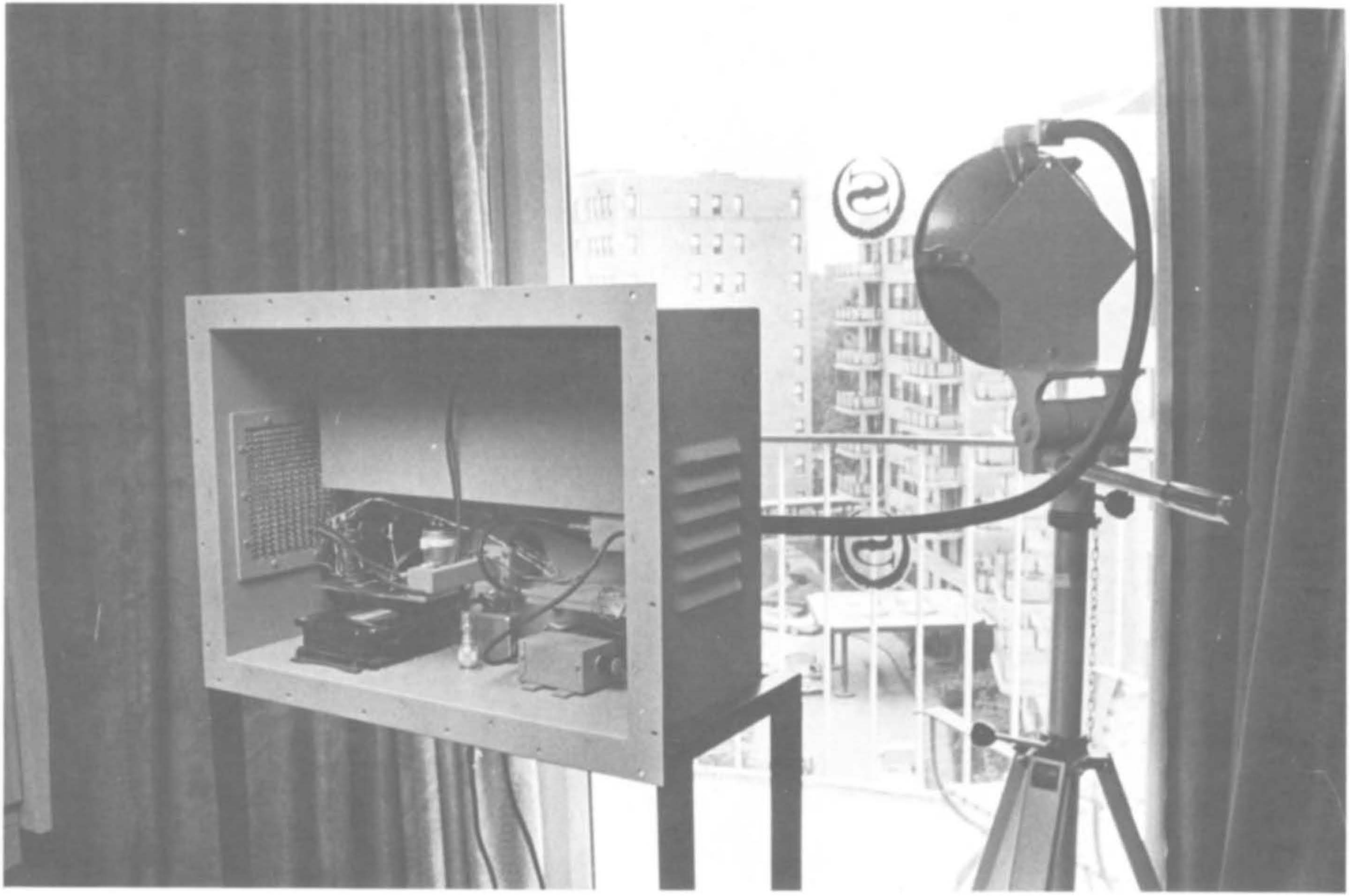


FIG. 5

The Laser Link cableless CATV transmitting-receiving terminal in Garden City, NY incorporates quasi laser link concept of antenna and parabollic reflector equipment at top. Back view shows transmitter housing containing modulation and amplification components.

FIG. 6

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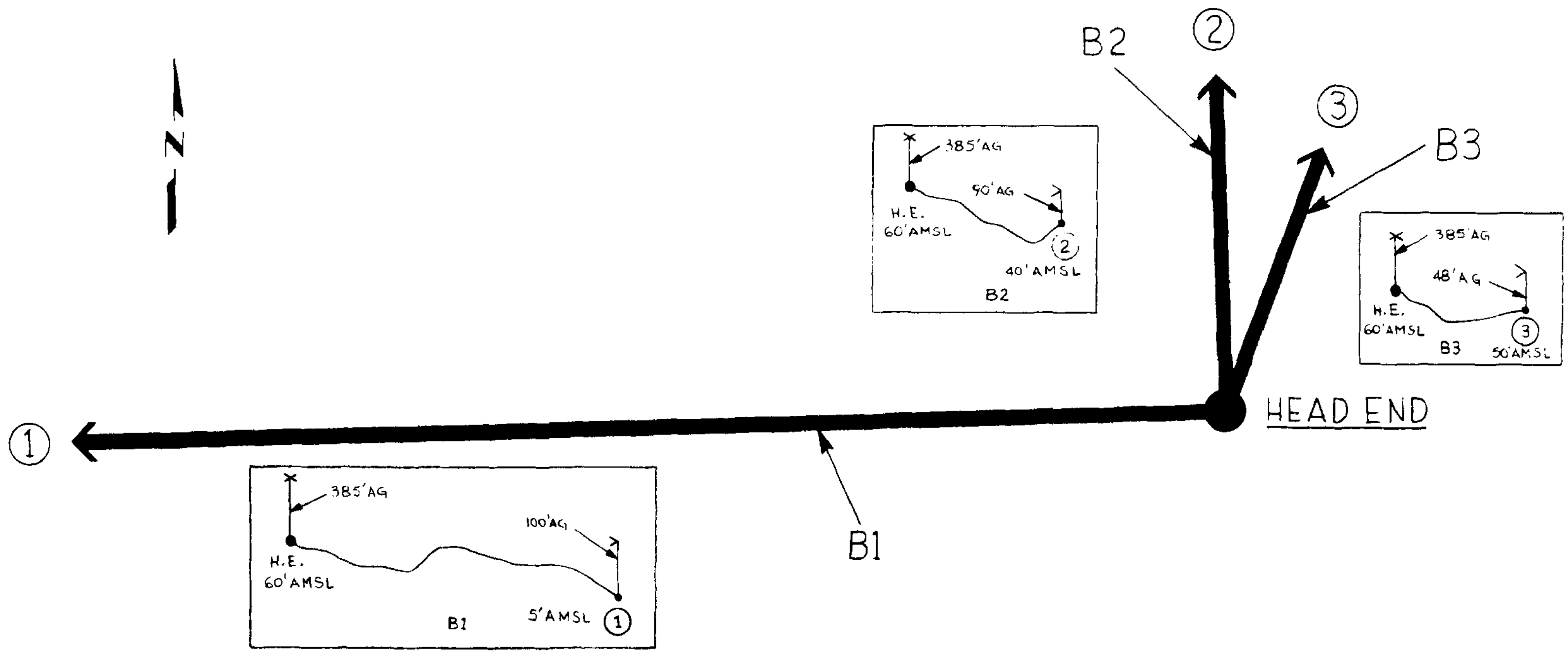

Site No.	Location	Miles to Head-end	Beam No.	Beam Power, W	Xmtr. or Rec'vr. Model	Xmtr. Antenna Size	Rec'vr. Antenna Size	Other
1	SMYRNA [illegible]	21	B1	18.0	12RTDA	10	10	–
2	[illegible]	[illegible]	B2	0.5	12R	4	4	–
3	[illegible]	5	B3	0.5	12R	4	4	-
Head-end	ORANGE CITY	–	–	19.0	12T	–	–	–

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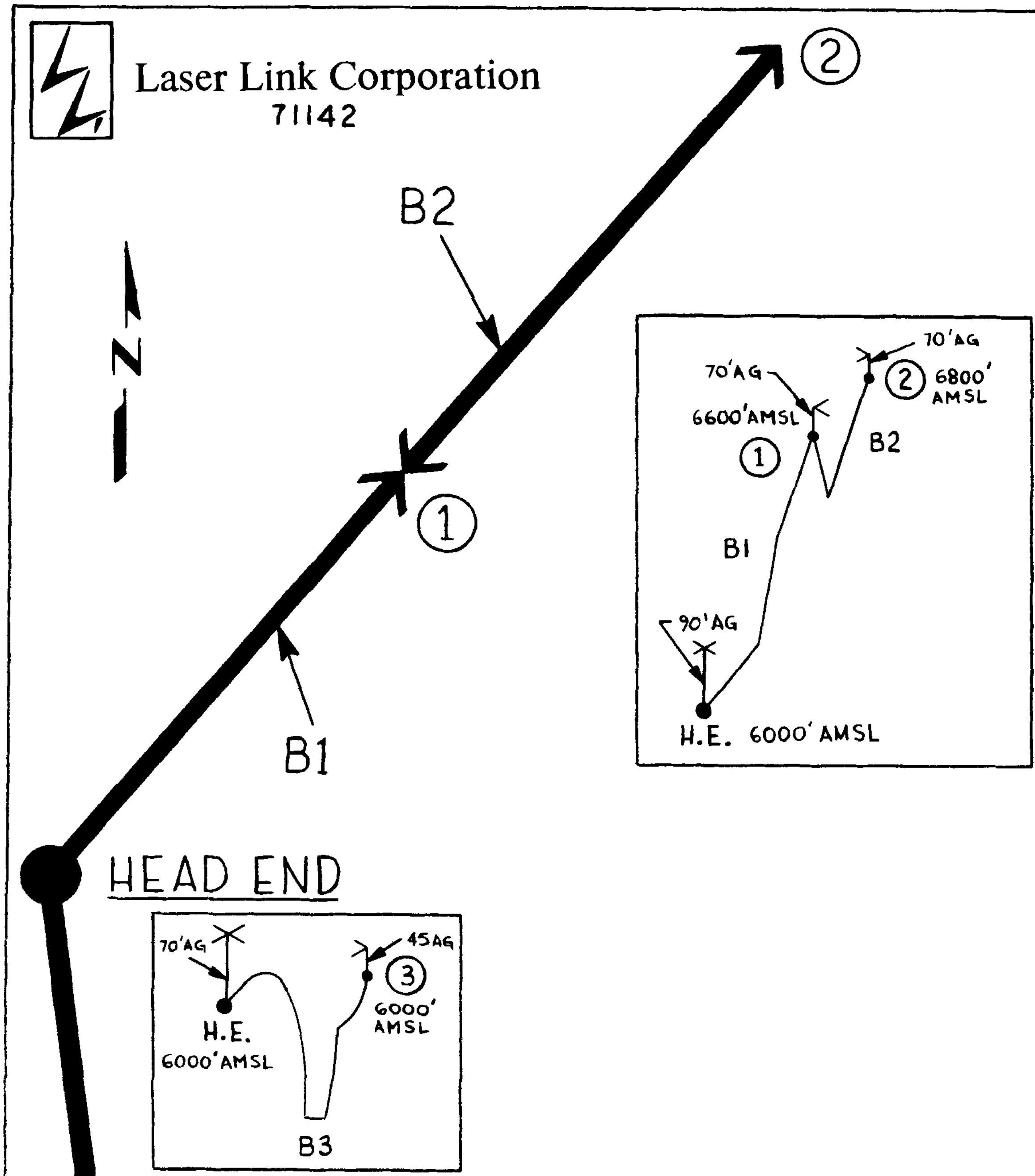
FIG. 7



Site No.	Location	Miles to Head-end	Beam No.	Beam Power, W	Xmtr. or Rec'vr. Model QLL-	Xmtr. Antenna Size FT	Rec'vr. Antenna Size FT	Other
1	PALMER PARK	3	B1	15	–	10	10	–
2	RATTLESNAKE HILL	4.5 (1)	B2	(2)	-12RTDA	10	10	–
3	STRATMORE HILLS	4	B3	0.1	-12R	4	4	–
Head-end	COLORADO SPRINGS							

Notes:
1. DISTANCE FROM RELAY SITE NO. 1
2. PASSIVE REPEATER OUTPUT FROM SITE NO. 1
3. RAIN RATE CAPABILITY = 1 in./hr.

FIG. 8

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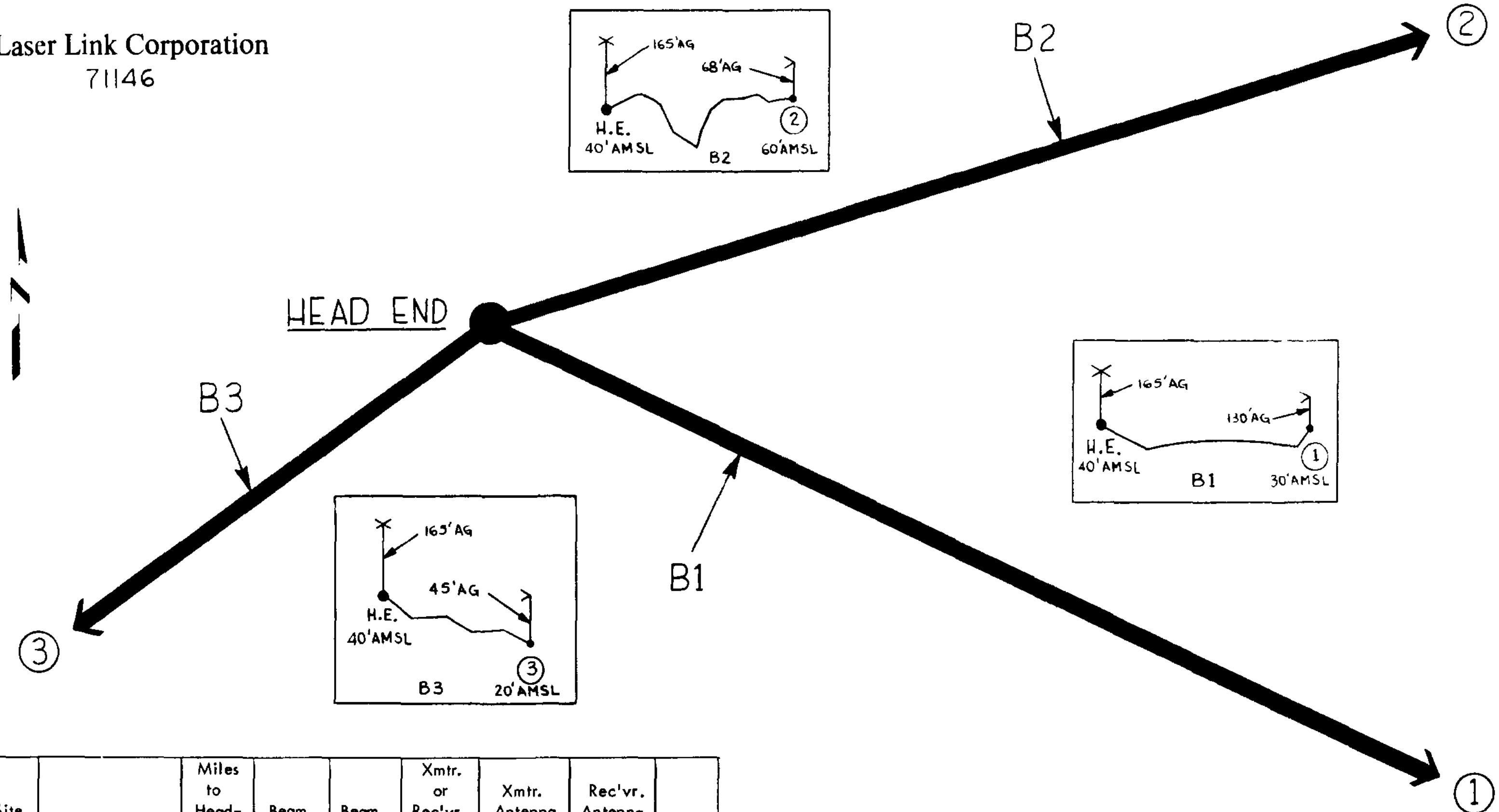
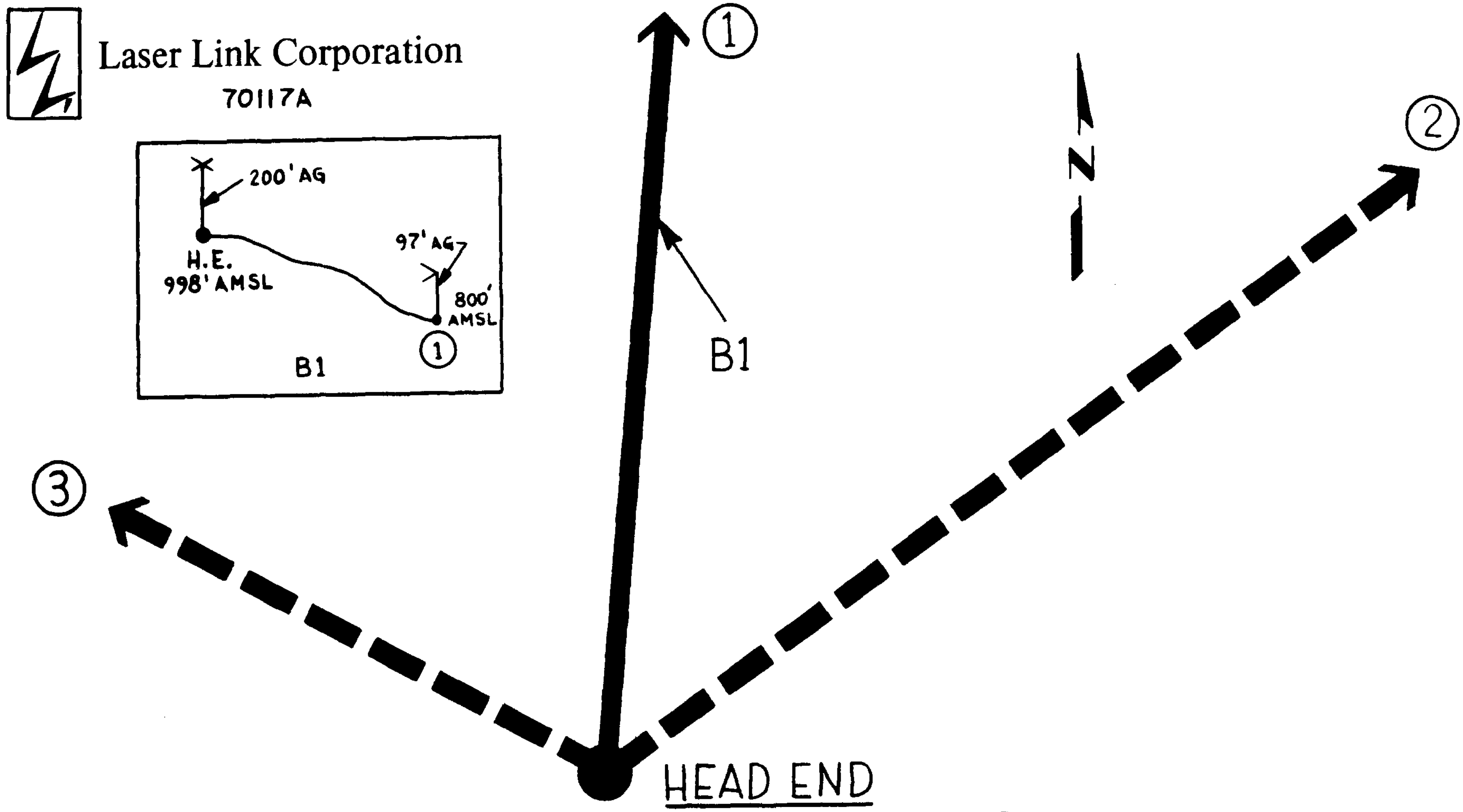


Site No.	Location	Miles to Head-end	Beam No.	Beam Power, W	Xmtr. or Rec'vr. Model QLL-	Xmtr. Antenna Size FT	Rec'vr. Antenna Size FT	Other
1	DESTIN	9.7	B1	4	-12R	10	4	–
2	EGLIN AFB, BUILD. 859	9.0	B2	14 (1)	-12R	4	4	–
3	EGLIN AFB, HURLBURT FLD	4.6	B3	1	-12R	4	4	–
Head-end	WRIGHT	–	–	19	-12T	–	–	–

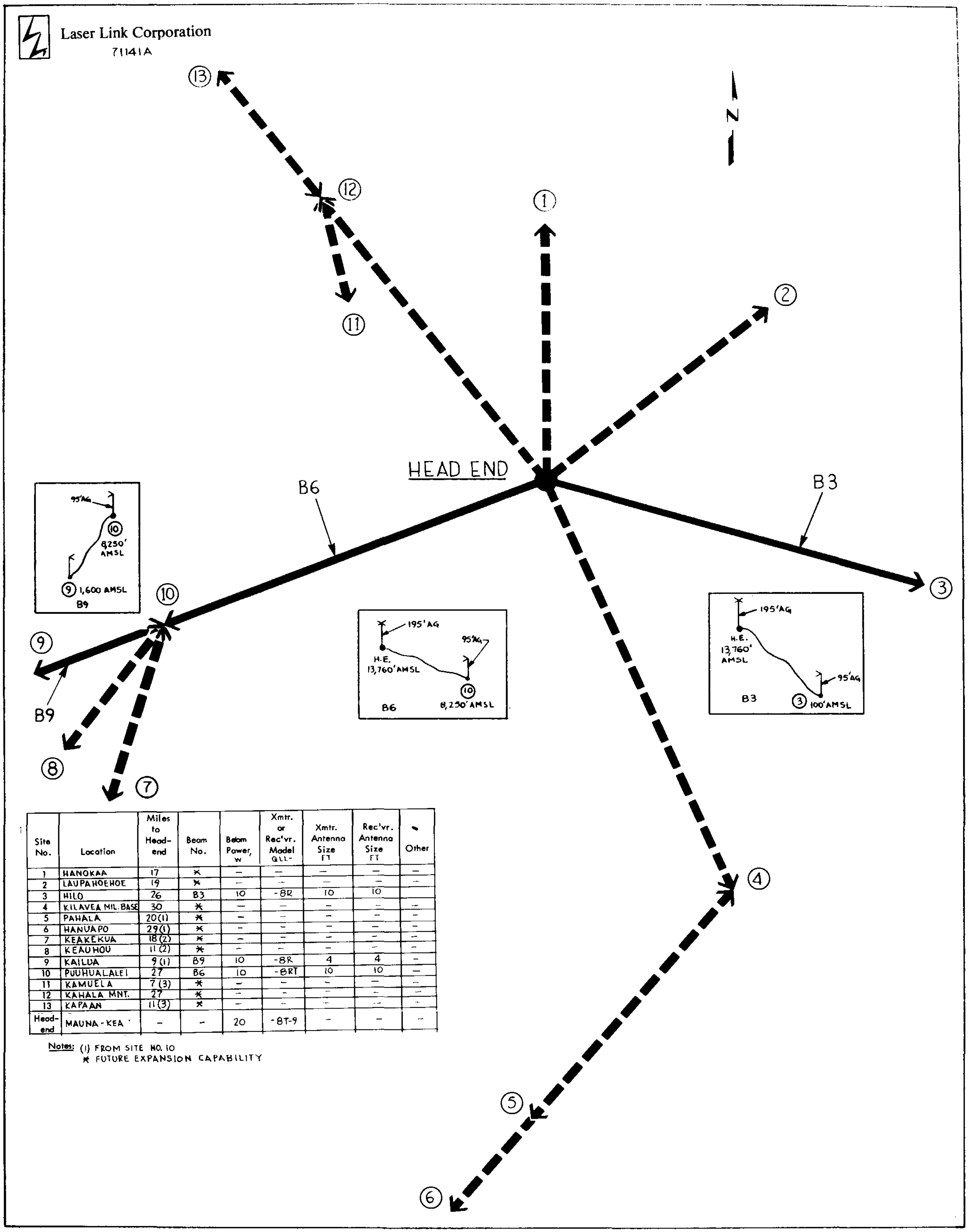
Notes: 1. PROVIDES FOR EXPANSION CAPABILITY TO NELSON POINT WHEN REQ'D.



Site No.	Location	Miles to Head-end	Beam No.	Beam Power, w	Xmtr. or Rec'vr. Model QLL-	Xmtr. Antenna Size FT	Rec'vr. Antenna Size FT	Other
1	CALIFORNIA	21	B1	19	12RTDA	10	10	–
2	JEFFERSON CITY	29	*	–	–	–	–	–
3	VERSAILLES	15	*	–	–	–	–	–
Head-end	ELDON	–	–	19	12T	–	–	–

Notes: RAIN RATE CAPABILITY = 1 in/hr
* FUTURE EXPANSION CAPABILITY

FIG. 10



Site No.	Location	Miles to Head-end	Beam No.	Beam Power, W	Xmtr. or Rec'vr. Model QLL-	Xmtr. Antenna Size FT	Rec'vr. Antenna Size FT	Other
1	HANOKAA	17	*	–	–	–	–	–
2	LAUPAHOEHOE	19	*	–	–	–	–	–
3	HILO	26	B3	10	-8R	10	10	
4	KILAVEA MIL. BASE	30	*	–	–	–	–	–
5	PAHALA	20(1)	*	–	–	–	–	–
6	HANUAPO	29(1)	*	–	–	–	–	–
7	KEAKEKUA	18(2)	*	–	–	–	–	–
8	KEAUHOU	11(2)	*	–	–	–	–	–
9	KAILUA	9(1)	B9	10	-8R	4	4	–
10	PUUHUALALEI	27	B6	10	-8RT	10	10	–
11	KAMUELA	7(3)	*	–	–	–	–	–
12	KAHALA MNT.	27	*	–	–	–	–	–
13	KAPAAN	11(3)	*	–	–	–	–	–
Head-end	MAUNA-KEA	–	–	20	-8T-9	–	–	–

Notes: (1) FROM SITE NO. 10
* FUTURE EXPANSION CAPABILITY

FIG. 11

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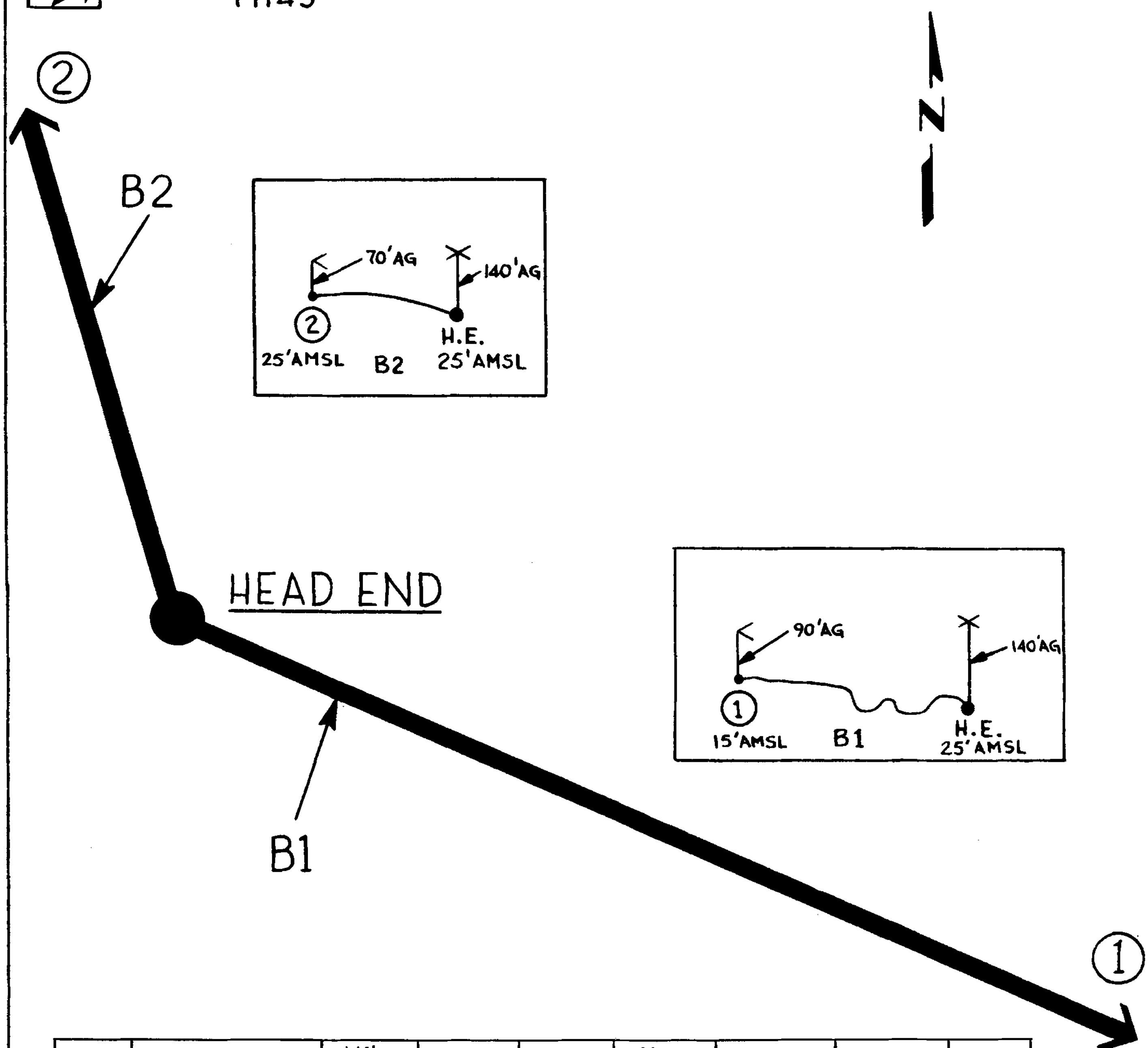
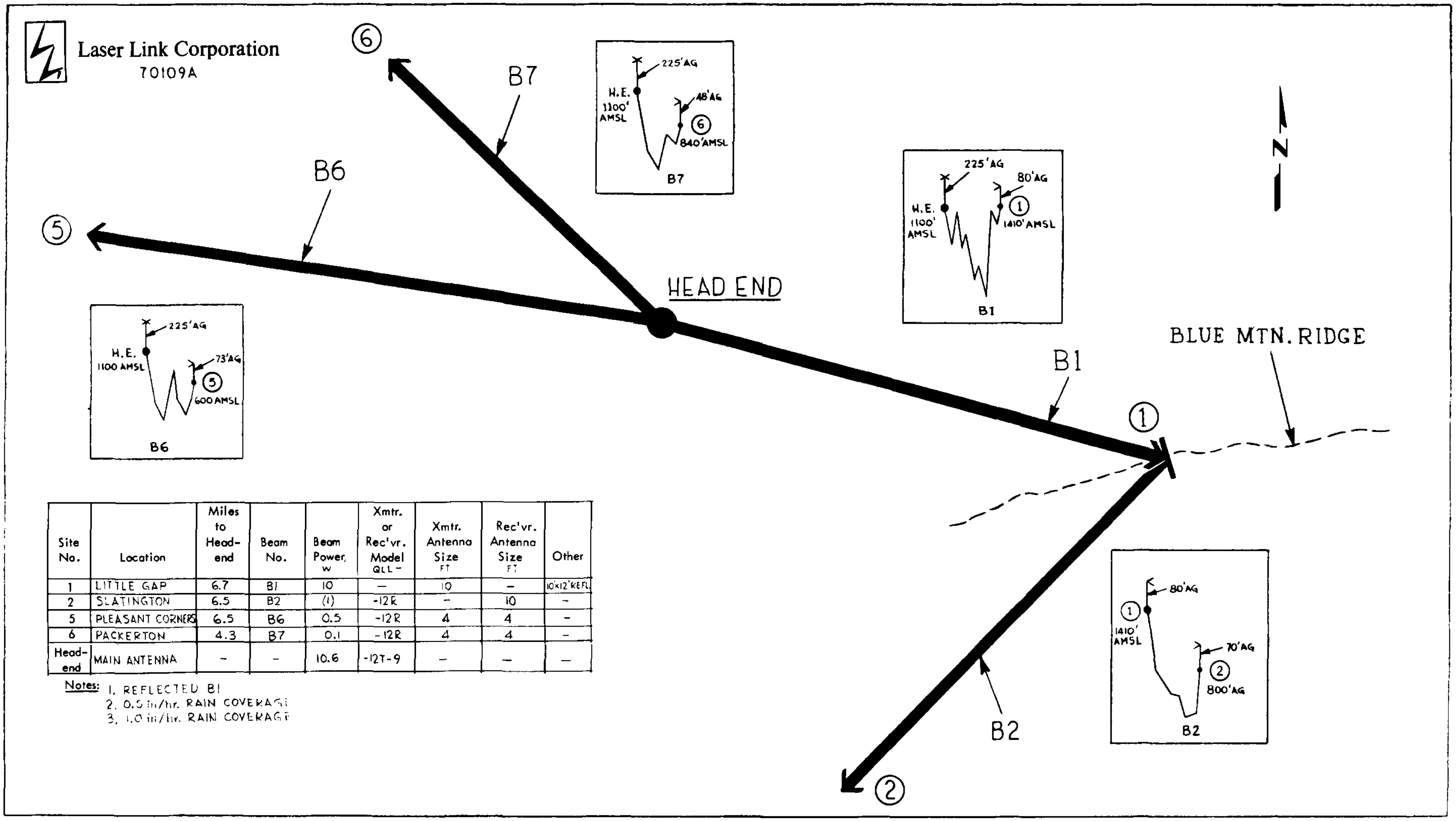


Site No.	Location	Miles to Head-end	Beam No.	Beam Power, W	Xmtr. or Rec'vr. Model QLL-	Xmtr. Antenna Size FT	Rec'vr. Antenna Size FT	Other
1	FLOWER BLUFF	9	B1	5	-12R	4	4	–
2	N. CORPUS CHRISTI	4	B2	1	-12R	4	4	–
Head-end	CORPUS CHRISTI	–	–	6	-12T	–	–	–

Notes: RAIN RATE CAPABILITY = 1 in/hr

FIG. 12



Site No.	Location	Miles to Head-end	Beam No.	Beam Power, W	Xmtr. or Rec'vr. Model QLL-	Xmtr. Antenna Size FT	Rec'vr. Antenna Size FT	Other
1	LITTLE GAP	6.7	B1	10	–	10	–	10'x12' REFL.
2	SLATINGTON	6.5	B2	(1)	-12R	–	10	–
5	PLEASANT CORNERS	6.5	B6	0.5	-12R	4	4	–
6	PACKERTON	4.3	B7	0.1	-12R	4	4	–
Head-end	MAIN ANTENNA	–	–	10.6	-12T-9	–	–	–

Notes: 1. REFLECTED B1
2. 0.5 in/hr. RAIN COVERAGE
3. 1.0 in/hr. RAIN COVERAGE

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FIG. 13

TABLE I

COST COMPARISON OF LASER LINK AIRLINK AND TRUNK CABLE

TYPE	AIR DISTANCE FROM HEAD END	AIRLINK FOR VARIOUS RAIN RATES 0.5 inch/hr	1 inch/hr		HI PERFORMANCE CABLE TRUNK		
		S/N Ratio	S/N Ratio	Quoted Price	S/N	Capital Cost	Pole Rental
Single Hop	18 miles	52	45	61.6	45	230	3
Three Directions	18	46	46		45		
	20	45	43	94.8	44	742	10
	20	45	43		44		
Five Directions	18	49	46		45		
	8	57	45	107.3	49	638	8
	8	57	45		49		
	8	57	45		49		
	8	57	45		49		
Ten Directions	10		46	147.3	48	1198	16
Seven Directions	25 Maximum	46	-	125.2	44	2226	28
Urban High Density 100 Sites	within 20 miles	46	-	101.4	42	2500	35

Costs in Thousands of Dollars:

Excellent pictures requires more than 42db channel S/N