

## LAMPIRAN A - Data Sheet Elliptical Waveguide



### DATA SHEET Elliptical Waveguide

Kabelwerk **EUPEN** AG

Rev.: 03/2007-05-24 cable

## EU 63

### CHARACTERISTICS

#### Construction

- **Construction**
  - Description **Elliptical corrugated copper tube**
- **Jacket**
  - Material **UV resistant, black polyethylene**
  - Thickness, mm (in) **1.8 (0.07)**
- **Dimensions**
  - Outer dimensions, mm (in) **51.5 x 30.6 (2.03 x 1.20)**

#### Mechanical characteristics

- **Minimum bending radius, without rebending**
  - E plane, mm (in) **200 (7.9)**
  - H plane, mm (in) **500 (19.7)**
- **Minimum bending radius, with rebending**
  - E plane, mm (in) **300 (11.8)**
  - H plane, mm (in) **700 (27.6)**
- **Min. drum core diameter, mm (in)** **1200 (47)**
- **Maximum operating pressure, bar (psi)** **0.5 (7.3)**
- **Max. pulling length per hoisting grip, m (ft)** **60 (197)**
- **Recommended temperature range**
  - Installation, °C (°F) **-20 to +60 (-4 to +140)**
  - Operation, °C (°F) **-40 to +80 (-40 to +176)**
- **Weight, kg/m (lb/ft)** **0.84 (0.56)**

#### Electrical characteristics

- **Frequency range, GHz** **5.70 - 7.75**
- **HEc11 Mode cutoff frequency, GHz** **4.2**

#### Attenuation, group velocity of propagation, power

Frequency GHz	Attenuation [1] dB/100m (dB/100ft)	Group velocity %	Avg. Power [2] kW
5.7	4.76 (1.45)	67.6	4.44
5.8	4.67 (1.42)	69.0	4.53
5.9	4.58 (1.40)	70.2	4.61
6.0	4.51 (1.37)	71.4	4.69
6.1	4.44 (1.35)	72.5	4.76
6.2	4.38 (1.33)	73.6	4.83
6.3	4.32 (1.32)	74.5	4.90
6.4	4.27 (1.30)	75.5	4.96
6.5	4.22 (1.29)	76.3	5.01
6.6	4.17 (1.27)	77.1	5.07
6.7	4.13 (1.26)	77.9	5.12
6.8	4.09 (1.25)	78.6	5.17
6.9	4.06 (1.24)	79.3	5.21
7.0	4.03 (1.23)	80.0	5.25
7.1	3.99 (1.22)	80.6	5.30
7.2	3.96 (1.21)	81.2	5.33
7.3	3.94 (1.20)	81.8	5.37
7.4	3.91 (1.19)	82.3	5.41
7.5	3.89 (1.18)	82.8	5.44
7.7	3.84 (1.17)	83.8	5.50
7.75	3.83 (1.17)	84.0	5.52

[1] Attenuation at 20°C (68°F)

[2] Average power ratings based on VSWR 1.0, 82°C (180 °F) inner temperature, 40°C (104 °F) ambient temperature.



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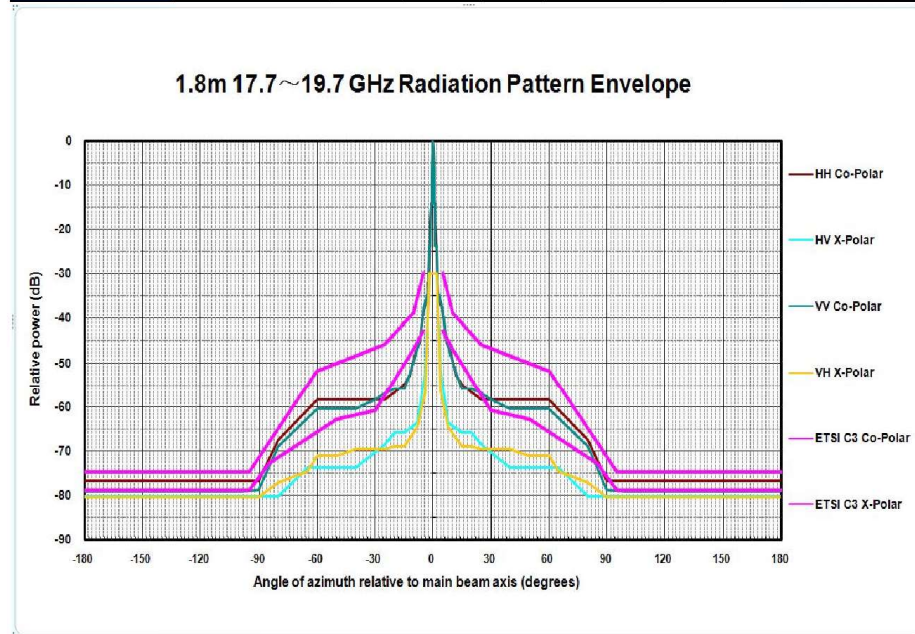
## LAMPIRAN B – Data sheet Antena 1,8 m



Microwave Products

### 1.8M Class3 Single-Pol. Microwave Antenna Electrical Specifications

Frequency Range(GHz)	Tongyu PN	Gain(dbi)			3dB BW (degs)	XPD (dB)	VSWR	F/B ratio (dB)
		Bottom	Middle	Top				
5.925-7.125	TYA18U06WS	38.5	39.4	39.8	1.7	30	1.3	65
7.125-8.5	TYA18U07WS	40.1	40.8	41.1	1.5	30	1.3	67
10.125-11.7	TYA18U10WS	42.7	43.5	44.4	1.1	30	1.3	70
10.7-11.7	TYA18U011S	43.3	43.8	44.4	1.1	30	1.3	70
12.75-13.25	TYA18U013S	44.8	45.2	45.5	0.9	30	1.3	72
14.4-15.35	TYA18U015S	45.9	46.2	46.5	0.8	30	1.3	74
17.7-19.7	TYA18U018S	47	47.8	48.4	0.7	30	1.3	76
21.2-23.6	TYA18U023S	48.9	49.4	49.9	0.5	30	1.3	79



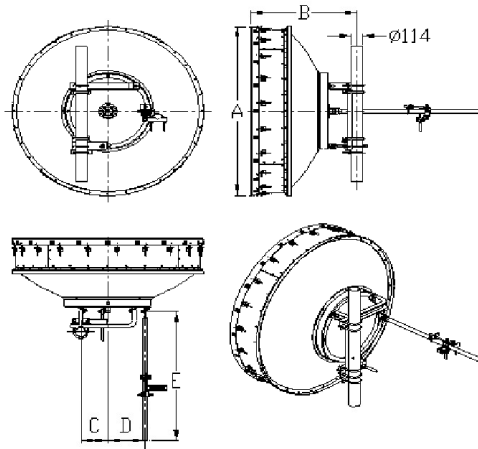
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20

Mechanical

Specifications

Azimuth Adjustment	Coarse : 360 ° Fine : ±5 °
Elevation Adjustment	Coarse : ±5° Fine : ±5°
Diameter of Mounting Pole (mm)	Φ51~Φ114
Wind Velocity Survival Rating (m/s)	70
Wind Velocity Operational (m/s)	56
Ice-load (mm)	25.4
Operational Temperature (°C)	-45~+60
Axial Force (N)	9758
Side Force (N)	4816
Twisting Moment (N•m)	2728



Dimensions(mm)					
Antenna Size(m)	A	B	C	D	E
1.8	1877	1044	265	367	1955

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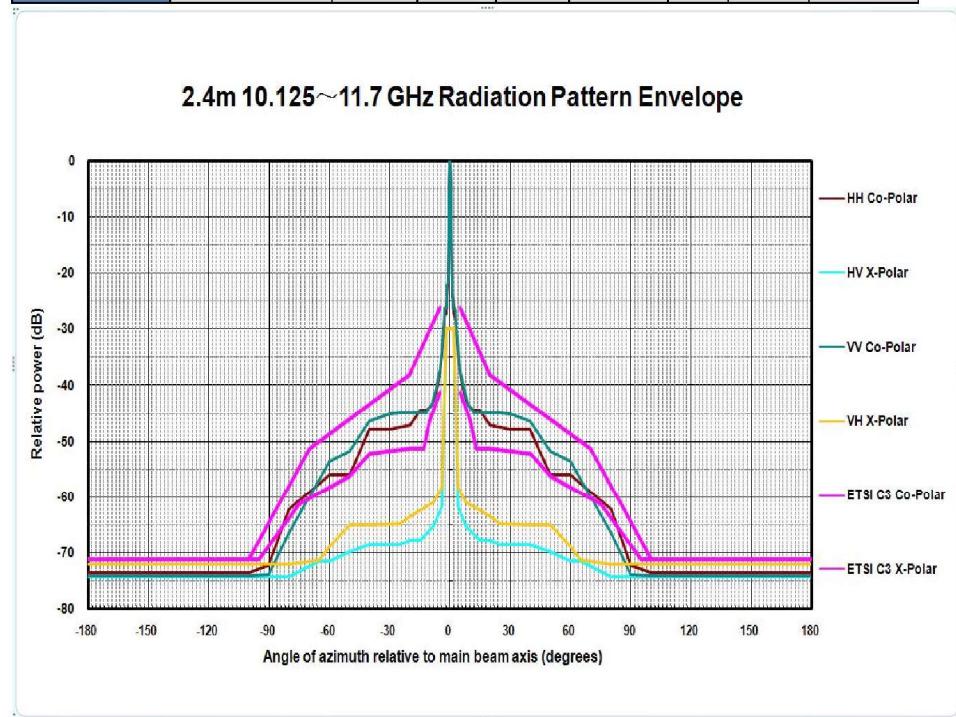
## LAMPIRAN C – Data sheet Antena 2,4 m



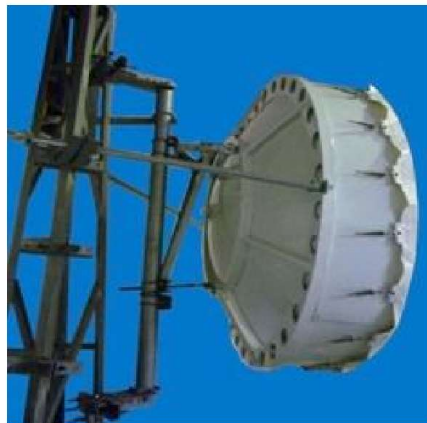
Microwave Products

### 2.4M Class3 Single-Pol. Microwave Antenna Electrical Specifications

Frequency Range(GHz)	Tongyu PN	Gain(dbi)			3dB BW (degs)	XPD (dB)	VSWR	F/B ratio (dB)
		Bottom	Middle	Top				
5.925-7.125	TYA24U06WS	40.8	41.7	42.5	1.4	30	1.3	67
7.125-8.5	TYA24U07WS	42.4	43.3	44	1.1	30	1.3	68
10.125-11.7	TYA24U10WS	45.1	46.2	46.8	0.8	30	1.3	71
10.7-11.7	TYA24U011S	46	46.4	46.8	0.8	30	1.3	71
12.75-13.25	TYA24U013S	47.5	47.7	47.8	0.7	30	1.3	73



Mechanical	Specifications
Azimuth Adjustment	Coarse : 360 °    Fine : ±15 °
Elevation Adjustment	Fine : ±5°
Diameter of Mounting Pole (mm)	Φ51~Φ114
Wind Velocity Survival Rating (m/s)	67
Wind Velocity Operational (m/s)	30
Ice-load (mm)	25.4
Operational Temperature (°C)	-45~+60
Axial Force (N)	17455
Side Force (N)	8598
Twisting Moment (N•m)	11545



## LAMPIRAN D – Data Sheet Radio RTN 950 7G-XMC2-256Q28M

OptiX RTN 950A Radio Transmission System  
Product Description

6 Technical Specifications

Frequency Band	Frequency Range (GHz)	T/R Spacing (MHz)
18 GHz	17.685 to 19.710	1008, 1010
23 GHz	21.200 to 23.618	1008, 1232

### 6.1.3 Receiver Sensitivity

The receiver sensitivity reflects the anti-fading capability of the microwave equipment.

**NOTE**

For a guaranteed value, remove 3 dB from the typical value.

#### 6.1.3.1 Receiver Sensitivity (IF1 Board)

The IF1 board supports SDH/PDH microwave work modes.

**NOTE**

For an XMC-1 ODU or XMC-2 ODU at the 18 GHz frequency band, remove 2 dB from the sensitivity values specified in the table.

**Table 6-35** Typical receiver sensitivity of the SDH/PDH microwave (i, IF1 board)

Item	Performance					
	4xE1		8xE1		16xE1	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
RSL@ BER = 10 <sup>-6</sup> (dBm)						
@6 GHz	-91.5	-87.5	-88.5	-84.5	-85.5	-81.5
@7 GHz	-91.5	-87.5	-88.5	-84.5	-85.5	-81.5
@8 GHz	-91.5	-87.5	-88.5	-84.5	-85.5	-81.5
@10 GHz	-91.0	-87.0	-88.0	-84.0	-85.0	-81.0
@10.5 GHz	-89.0	-85.0	-86.0	-82.0	-83.0	-79.0
@11 GHz	-91.0	-87.0	-88.0	-84.0	-85.0	-81.0
@13 GHz	-91.0	-87.0	-88.0	-84.0	-85.0	-81.0
@15 GHz	-91.0	-87.0	-88.0	-84.0	-85.0	-81.0
@18 GHz	-91.0	-87.0	-88.0	-84.0	-85.0	-81.0
@23 GHz	-90.5	-86.5	-87.5	-83.5	-84.5	-80.5
@26 GHz	-90.0	-86.0	-87.0	-83.0	-84.0	-80.0

Item	Performance					
	4xE1		8xE1		16xE1	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
@32 GHz	-89.0	-85.0	-86.0	-82.0	-83.0	-79.0
@38 GHz	-88.5	-84.5	-85.5	-81.5	-82.5	-78.5

**Table 6-36** Typical receiver sensitivity of the SDH/PDH microwave (ii, IF1 board)

Item	Performance					
	22xE1	26xE1	35xE1	44xE1	53xE1	STM-1
	32QAM	64QAM	16QAM	32QAM	64QAM	128QAM
RSL@ BER = 10 <sup>-6</sup> (dBm)						
@6 GHz	-80.5	-76.5	-79.0	-77.5	-73.5	-70.5
@7 GHz	-80.5	-76.5	-79.0	-77.5	-73.5	-70.5
@8 GHz	-80.5	-76.5	-79.0	-77.5	-73.5	-70.5
@10 GHz	-80.0	-76.0	-78.5	-77.0	-73.0	-70.0
@10.5 GHz	-78.0	-74.0	-76.5	-75.0	-71.0	-68.0
@11 GHz	-80.0	-76.0	-78.5	-77.0	-73.0	-70.0
@13 GHz	-80.0	-76.0	-78.5	-77.0	-73.0	-70.0
@15 GHz	-80.0	-76.0	-78.5	-77.0	-73.0	-70.0
@18 GHz	-80.0	-76.0	-78.5	-77.0	-73.0	-70.0
@23 GHz	-79.5	-75.5	-78.0	-76.5	-72.5	-69.5
@26 GHz	-79.0	-75.0	-77.5	-76.0	-72.0	-69.0
@32 GHz	-78.0	-74.0	-76.5	-75.0	-71.0	-68.0
@38 GHz	-77.5	-73.5	-76.0	-74.5	-70.5	-67.5

### 6.1.3.2 Receiver Sensitivity (IFU2 board)

The IFU2 board supports Integrated IP microwave work modes.

### 6.1.5 Transceiver Performance

The performance of the transceiver includes the nominal maximum/minimum transmit power, nominal maximum receive power, and frequency stability.

**NOTE**

When cooperated with ISV3/ISM6 boards, ODU's may support QPSK Strong, 16QAM Strong, 512QAM Light, and 1024QAM Light working modes. Strong and light indicate FEC coding strength. Strong FEC improves receiver sensitivity by increasing error-correcting codes. Light FEC expands service capacity by reducing error-correcting codes. For detail, refer to [6.1.1.4 Microwave Work Modes \(ISV3 board\)](#).

#### Transceiver Performance (High Power ODU)

**NOTE**

- In normal mode, XMC ODUs work with IFU2, ISU2, or ISX2 boards, or ISV3 boards that work in IS2 mode.
- In IS3 mode, XMC ODUs work with ISV3/ISM6 boards that work in IS3 mode.
- In IS6 mode, XMC ODUs work with ISM6 boards that work in IS6 mode.

**Table 6-108** Transceiver performance (XMC-2 ODU in normal mode)

Item	Performance					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
<b>Nominal maximum transmit power (dBm)</b>						
<b>NOTE</b>						
For 7/8 GHz XMC-2 ODUs, when the channel spacing is 40 MHz or 56 MHz and the same modulation scheme is applied, the nominal maximum transmit power of an XMC-2 ODU of the normal version is less than the value in the table by 3 dB, whereas that of an XMC-2 ODU of the XMC-2E version is the same as the value in the table.						
6 GHz	30	28	26.5	25	25	23
7 GHz (Normal)	26.5	25.5	25.5	25	25	23
8 GHz (Normal)	26.5	25.5	25.5	25	25	23
7 GHz (XMC-2E)	30	26	26	25	25	23
8 GHz (XMC-2E)	30	26	26	25	25	23
10 GHz	26.5	23.5	23.5	21.5	21.5	19.5
10.5 GHz	24.5	22.5	22.5	20.5	20.5	18.5
11 GHz	26	24	24	22	22	20
13 GHz	25	22	22	20.5	20.5	17.5



**NOTE**

- For an XMC-2 ODU at the 18 GHz frequency band, remove 2 dB from the sensitivity values specified in the table.
- The 10.5 GHz ODU with the T/R spacing of 91 MHz does not support the channel spacing of 56 MHz. The receiver sensitivity is not available (N/A).

**Table 6-37** Typical receiver sensitivity of the Integrated IP microwave (i, IFU2 board)

Item	Performance (Channel Spacing: 7 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL @ BER=10 <sup>-6</sup> (dBm)						
@6 GHz	-92.5	-86.5	-82.5	-79.5	-76.5	-73.5
@7 GHz	-92.5	-86.5	-82.5	-79.5	-76.5	-73.5
@8 GHz	-92.5	-86.5	-82.5	-79.5	-76.5	-73.5
@10 GHz	-92	-86	-82	-79	-76	-73
@10.5 GHz	-90	-84	-80	-77	-74	-71
@11 GHz	-92	-86	-82	-79	-76	-73
@13 GHz	-92	-86	-82	-79	-76	-73
@15 GHz	-92	-86	-82	-79	-76	-73
@18 GHz	-92	-86	-82	-79	-76	-73
@23 GHz	-91.5	-85.5	-81.5	-78.5	-75.5	-72.5
@26 GHz	-91	-85	-81	-78	-75	-72
@28 GHz	-90.5	-84.5	-80.5	-77.5	-74.5	-71.5
@32 GHz	-90	-84	-80	-77	-74	-71
@38 GHz	-89.5	-83.5	-79.5	-76.5	-73.5	-70.5
@42 GHz	-88	-82	-78	-75	-72	-69

**Table 6-38** Typical receiver sensitivity of the Integrated IP microwave (ii, IFU2 board)

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL @ BER=10 <sup>-6</sup> (dBm)						
@6 GHz	-90.5	-83.5	-79.5	-76.5	-73.5	-70.5

Item	Performance (Channel Spacing: 14 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@7 GHz	-90.5	-83.5	-79.5	-76.5	-73.5	-70.5
@8 GHz	-90.5	-83.5	-79.5	-76.5	-73.5	-70.5
@10 GHz	-90	-83	-79	-76	-73	-70
@10.5 GHz	-88	-81	-77	-74	-71	-68
@11 GHz	-90	-83	-79	-76	-73	-70
@13 GHz	-90	-83	-79	-76	-73	-70
@15 GHz	-90	-83	-79	-76	-73	-70
@18 GHz	-90	-83	-79	-76	-73	-70
@23 GHz	-89.5	-82.5	-78.5	-75.5	-72.5	-69.5
@26 GHz	-89	-82	-78	-75	-72	-69
@28 GHz	-88.5	-81.5	-77.5	-74.5	-71.5	-68.5
@32 GHz	-88	-81	-77	-74	-71	-68
@38 GHz	-87.5	-80.5	-76.5	-73.5	-70.5	-67.5
@42 GHz	-86	-79	-75	-72	-69	-66

Table 6-39 Typical receiver sensitivity of the Integrated IP microwave (iii, IFU2 board)

Item	Performance (Channel Spacing: 28 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10 <sup>-6</sup> (dBm)						
@6 GHz	-87.5	-80.5	-76.5	-73.5	-70.5	-67.5
@7 GHz	-87.5	-80.5	-76.5	-73.5	-70.5	-67.5
@8 GHz	-87.5	-80.5	-76.5	-73.5	-70.5	-67.5
@10 GHz	-87	-80	-76	-73	-70	-67
@10.5 GHz	-85	-78	-74	-71	-68	-65
@11 GHz	-87	-80	-76	-73	-70	-67
@13 GHz	-87	-80	-76	-73	-70	-67
@15 GHz	-87	-80	-76	-73	-70	-67

Item	Performance (Channel Spacing: 28 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
@18 GHz	-87	-80	-76	-73	-70	-67
@23 GHz	-86.5	-79.5	-75.5	-72.5	-69.5	-66.5
@26 GHz	-86	-79	-75	-72	-69	-66
@28 GHz	-85.5	-78.5	-74.5	-71.5	-68.5	-65.5
@32 GHz	-85	-78	-74	-71	-68	-65
@38 GHz	-84.5	-77.5	-73.5	-70.5	-67.5	-64.5
@42 GHz	-83	-76	-72	-69	-66	-63

Table 6-40 Typical receiver sensitivity of the Integrated IP microwave (iv, IFU2 board)

Item	Performance (Channel Spacing: 56 MHz)					
	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
RSL@ BER=10 <sup>-6</sup> (dBm)						
@6 GHz	-84.5	-77.5	-73.5	-70.5	-67.5	-64.5
@7 GHz	-84.5	-77.5	-73.5	-70.5	-67.5	-64.5
@8 GHz	-84.5	-77.5	-73.5	-70.5	-67.5	-64.5
@10 GHz	-84	-77	-73	-70	-67	-64
@10.5 GHz	N/A	N/A	N/A	N/A	N/A	N/A
@11 GHz	-84	-77	-73	-70	-67	-64
@13 GHz	-84	-77	-73	-70	-67	-64
@15 GHz	-84	-77	-73	-70	-67	-64
@18 GHz	-84	-77	-73	-70	-67	-64
@23 GHz	-83.5	-76.5	-72.5	-69.5	-66.5	-63.5
@26 GHz	-83	-76	-72	-69	-66	-63
@28 GHz	-82.5	-75.5	-71.5	-68.5	-65.5	-62.5
@32 GHz	-82	-75	-71	-68	-65	-62
@38 GHz	-81.5	-74.5	-70.5	-67.5	-64.5	-61.5
@42 GHz	-80	-73	-69	-66	-63	-60

## 6.1 RF Performance

This chapter describes the radio frequency (RF) performance and various technical specifications related to microwaves.

### 6.1.1 Microwave Work Modes

This section lists the microwave work modes that the OptiX RTN 950A supports base on IF boards.

#### 6.1.1.1 Microwave Work Modes (IFU2 board)

The IFU2 board supports Integrated IP microwave work modes.

**NOTE**

The channel spacings supported by the OptiX RTN 950A comply with ETSI standards. Channel spacings 14/28/56 MHz apply to most frequency bands; but channel spacings 13.75/27.5/55 MHz apply to the 18 GHz frequency band.

**Table 6-1** Integrated IP microwave work modes (IFU2 board)

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of EIs in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)
7	QPSK	5	9 to 12
7	16QAM	10	20 to 24
7	32QAM	12	24 to 29
7	64QAM	15	31 to 37
7	128QAM	18	37 to 44
7	256QAM	21	43 to 51
14 (13.75)	QPSK	10	20 to 23
14 (13.75)	16QAM	20	41 to 48
14 (13.75)	32QAM	24	50 to 59
14 (13.75)	64QAM	31	65 to 76
14 (13.75)	128QAM	37	77 to 90
14 (13.75)	256QAM	43	90 to 104
28 (27.5)	QPSK	20	41 to 48
28 (27.5)	16QAM	40	82 to 97

Channel Spacing (MHz)	Modulation Scheme	Maximum Number of E1s in Hybrid Microwave	Native Ethernet Throughput (Mbit/s)
28 (27.5)	32QAM	52	108 to 125
28 (27.5)	64QAM	64	130 to 150
28 (27.5)	128QAM	75	160 to 180
28 (27.5)	256QAM	75	180 to 210
56 (55)	QPSK	40	82 to 97
56 (55)	16QAM	75	165 to 190
56 (55)	32QAM	75	208 to 240
56 (55)	64QAM	75	260 to 310
56 (55)	128QAM	75	310 to 360
56 (55)	256QAM	75	360 to 420

**NOTE**

For the integrated IP microwave work mode that the IFU2 board supports:

- The throughput specifications listed in the tables are based on untagged Ethernet frames with a length ranging from 64 bytes to 1518 bytes
- E1 services need to occupy the corresponding bandwidth of the air interface capacity. The bandwidth remaining after the E1 service capacity is subtracted from the air interface capacity can be provided for Ethernet services.

### 6.1.1.2 Microwave Work Modes (ISU2 board)

The ISU2 board supports SDH microwave work modes and Integrated IP microwave work modes.

**NOTE**

The channel spacings supported by the OptiX RTN 950A comply with ETSI standards. Channel spacings 14.28/56 MHz apply to most frequency bands; but channel spacings 13.75/27.5/55 MHz apply to the 18 GHz frequency band.

### SDH Microwave Work Modes

**Table 6-2** SDH microwave work modes (ISU2 board)

Service Capacity	Modulation Scheme	Channel Spacing (MHz)
STM-1	128QAM	28 (27.5)
2xSTM-1	128QAM	56 (55)