System 8000 Fiber-Optic Interfacility Links

Designed to interface directly with earth station equipment, the multifaceted System 8000 interfacility link offers a wide variety of unique, site-specific interconnectivity solutions for satellite earth stations.

Features

- Single thread, 1:1, and 1:2 redundancy
- EIRP monitoring capability
- RS-232 or RS-485 serial interface
- RS-232 or RS-422 data link
- RFI/EMI immunity
- CE approved

Applications

- C-, extended C-, X-, and Ku-band earth stations
- IF and L-band IFLs
- Rain-fade site diversity

Description

The system 8000 fiber-optic interfacility links represent a comprehensive and simplified approach to satellite earth station signal management and control. Essentially, the system is designed to bring microwave technology into the 21st Century by converting microwave signals into continuously variable amplitude-modulated optical signals.

Consisting of a high-performance, highly flexible family of fiber-optic transmitter and receiver plug-ins, system 8000 allows both microwave and RF signals to be transmitted over long distances through fiber-optic cable, and thereby eliminates the need for coaxial and waveguide interconnections. A fiber-optic link between the control room and antenna site allows for convenient remote monitoring and control as well.

The system can be tailored for a wide range of transmit/receive frequency bands and offers an extensive selection of unique, site-specific interconnectivity solutions for satellite earth stations, including:

- Configurable 19 in. x 3u (5.25 in.) equipment chassis that includes redundant power supplies; redundancy switching options: single thread, 1:1, and 1:2; and selectable serial interfaces, RS-232 or RS-485.
- Economical 70 MHz/140 MHz links for uplink antenna remoting, downconverter output distribution, and intersite connections for backup or antenna diversity.
- L-band links cover the 950 MHz—2050 MHz and can be used for block downconverted C-, extended C-, X-, or Ku-band signals, or for L-band Inmarsat transmit and receive applications.
- C-, extended C-, X-, and Ku-band uplink and downlink systems carry the main transmit and receive signals between the control room and the antenna site.

Description (continued)

- Remote RF monitor links measure the composite uplink signal at the uplink EIRP monitor coupler located at the antenna's input feed flange.
- Monitor and control data link provides a full-duplex, fiber-optic path for either RS-232C or RS-422 data for the earth station's monitor and control system.

Status information, including alarms and warnings, is indicated by front panel LEDs and through standard system monitor and control serial data ports on the chassis rear panel.

Absolute Maximum Ratings

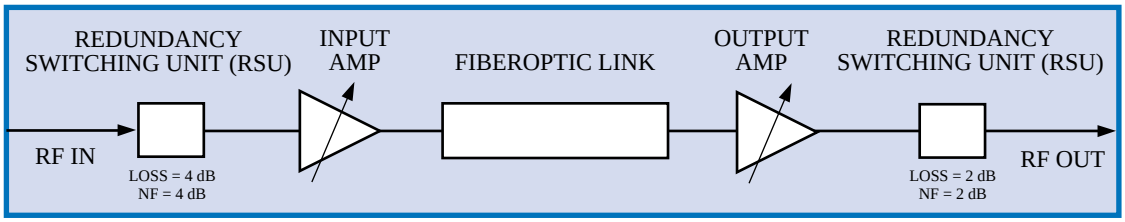
Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	Symbol	Min	Max	Unit
Operating Temperature Range	T_C	0	50	°C
Storage Temperature Range	Tstg	–20	+60	°C
Power Requirements: 8001A Chassis With 8010A (Factory Set) Status and Control Plug Transmitter Plug-in Receiver Plug-in	—	 115/60 — — —	 230/50 5 18 5.2	 Vac/Hz W W W
RF Input	RF_{IN}	—	2	V
Surge Protection*	—	—	—	—
Humidity, Noncondensing	RH	5	95	%

*A 500 V transient developed across 100 pF is discharged through 1500 Ω to each connector pin without damaging the system.

Typical Block Diagram

As indicated in the block diagram below, the input and output amplifiers are integral to the system 8000. The tables presented throughout the following sections, however, give the expected performance of each functional block in the link with respect to their corresponding performance bands, including 70 MHz—140 MHz, L-band, and C-, X-, and Ku-band interfacility links. These specifications, along with those for remote RF signal monitor interfacility links and fiber-optic data links, are presented to aid in generating level diagrams for overall system analysis.



70 MHz/140 MHz Interfacility Link Specification

These links are designed to interconnect the up- and downconverters with the satellite modems or video exciters and demodulators. They are specified to meet and exceed Intelsat requirements to 70 km. They are ideal for interconnections on site, to and from a diverse antenna site and for local access between a teleport and the end user. The 70 MHz/140 MHz links are available as nonredundant or 1:1 redundant links only.

Table 1. 70 MHz/140MHz Interfacility Link Specification: 8603A Tx/8604A Rx, Options -001, -002, -050

Parameter	Specification				
	Symbol	Min	Typ	Max	Unit
Passband	—	40	—	200	MHz
Optical Loss	L_{OPT}	0	—	30	dB
Nominal RF Input at Max Input Gain	RF_{IN}	—	–22	—	dBm
Link Gain (–2 dB L_{OPT}; –6 dB with Redundancy Switching):	G				
8603A/8604A		0	—	9	dB
8603A-001/8604A-002		11	—	20	dB
8603A-001/8604A		23	—	32	dB
8603A-002/8604A-001		35	—	44	dB
Flatness	—	—	±0.25/40	—	dB/MHz
Gain Slope	—	—	0.02	—	dB/MHz
Gain Stability at Constant Temperature	ΔG_T	—	±0.15/24	—	dB/hr
Noise Figure at Max Input Gain (Add 4 dB with Redundancy Switching):	NF				
8603A		—	25 (1)	—	dB (km)
		—	38 (10)	—	dB (km)
8603A-001/8603A-002		—	28 (10)	—	dB (km)
		—	34 (24)	—	dB (km)
		—	37 (40)	—	dB (km)
		—	52 (65)	—	dB (km)
Linearity (Third-Order Intermodulation Products Max Input Gain, P_{IN} = –27 dBm/Carrier for Two Equilevel Carriers)	—	—	C/I = 60	—	dB
Group Delay:	—				
Peak-to-Peak		—	1.0	—	ns
Linear		—	0.05	—	ns/MHz
Parabolic		—	0.015	—	ns/MHz^2
Input/Output Impedance:	Z				
Standard		—	75	—	Ω
Option 050		—	50	—	Ω
Input/Output VSWR	—	—	1.3:1	—	—
Spur-Free Dynamic Range*	SDFR	—	—	—	—
RF Connector	—	BNC			—
Optical Fiber	—	1310 nm, Single Mode			—
Optical Connector	—	FC/APC (Tight-fit Keying), Return Loss > 60			— dB
Absolute Maximum RF Input (Max Input Gain)	$RF_{IN\ MAX}$	—	—	–5	dBm

* Spur-free dynamic range (SFDR) = 2/3(IP3 – NF + 173.8) $dB/Hz^{2/3}$; IP3 = input third-order intercept, NF = noise figure. SFDR is the range where the carrier is above the noise and the third IM is below the noise, C/I = 2x(IP3 – P_{IN}), where P_{IN} = input RF/carrier for two carriers.

70 MHz/140 MHz Interfacility Link Specification (continued),

Table 2. 70 MHz/140 MHz Interfacility Link: 8603A Tx and 8604A Rx, (0 km to 10 km)

Parameter	Symbol	Input Amp		Fiber-Optic Link 8063A	Output Amp 8064A	System (without RSU)		Unit
		Min	Max	Typ	Typ	Min	Max	
Gain	G	12	21	–33 – 2 LOPT	21	–2 LOPT	9 – 2 LOPT	dB
Noise Figure	NF	17	8	—	4	—	—	dB
0 km		—	—	45	—	34	25	dB
10 km		—	—	59	—	47	38	dB
Output IP3	—	30	30	—	26	—	—	dB
0 km, 0.5 dB LOPT		—	—	–1	—	15	15	dB
10 km, 5 dB LOPT		—	—	–11	—	7	7	dB

Table 3. 70 MHz/140 MHz Interfacility Link: 8603A-001 Tx and 8604A-002 Rx (10 km to 30 km); 8603A-001 Tx and 8604A Rx (25 km to 45 km); 8603A-002 Tx and 8604A-001 Rx (45 km to 70km)

Parameter	Symbol	Input Amp		Fiber-Optic Link 8063A-001/8603A-002						Fixed Output Amp Typ			Unit
		Min	Max	Typ						8604A-002	8604A	8604A-001	
Gain	G	12	21	–10 – 2 LOPT						9	21	33	dB
Noise Fig.	NF	17	8	48 (10)	55 (30)	54 (25)	59 (45)	57 (40)	71 (65)	4	4	4	dB (km)
OutPut IP3	—	30	8	26 – 2 LOPT						26	26	26	dBm

L-Band Interfacility Link Specifications

The L-band links can carry a downconverted C-, X-, or Ku-band polarization. They can also carry the L-band transmit or receive signals for a satellite mobile communications feederlink station for systems such as Inmarsat. Each link is designed to meet and exceed all of the requirements for use in Intelsat Standard A and C earth stations even under the highest signal-loading conditions. The links are especially useful for routing signals to and from a diverse antenna site. One fiber is used in single-strand links and two are used in 1:1 redundant paths. Optionally, the path may share a fiber-optic link with another path in 1:2 redundant configurations.

Table 4: L-Band Interfacility Link Specifications: 8710A Tx and 8720A Rx

Parameter	Specification				
	Symbol	Min	Typ	Max	Unit
Passband	—	950	—	2050	MHz
Optical Loss Budget	L_{OPT}	—	>6	—	dB
Nominal RF Input at Max Input Gain	RF_{IN}	—	–30	—	dBm
Link Gain (–6 dB with Redundancy Switching)	G	–10	—	17	dB
Flatness	—	— —	±0.2/48 ±1.0/500	— —	dB/MHz dB/MHz
Gain Slope	—	—	0.02	—	dB/MHz
Gain Stability at Constant Temperature	ΔG_T	—	±0.15/24	—	dB/hr
Noise Figure at Max Input Gain (Add 4 dB with Redundancy Switching)	NF	—	20	—	dB
Spur-Free Dynamic Range*	SDFR	—	96	—	$dB/Hz^{2/3}$
Group Delay: Peak-to-Peak Linear Parabolic	—	 — — —	 0.5 0.02 0.01	 — — —	 ns ns/MHz ns/MHz^2
Input/Output Impedance	Z	—	50	—	Ω
Input/Output VSWR	—	—	1.5:1	—	—
RF Connector	—	N Jack			—
Optical Fiber	—	1310 nm, Single Mode			—
Optical Connector	—	FC/APC (Tight-fit Keying), Return Loss > 60			— dB
Absolute Maximum RF Input (Max Input Gain)	$RF_{IN\ MAX}$	—	—	–15	dBm

* Spur-free dynamic range (SFDR) = 2/3(IP3 – NF + 173.8) $dB/Hz^{2/3}$; IP3 = input third-order intercept, NF = noise figure. SFDR is the range where the carrier is above the noise and the third IM is below the noise, C/I = 2x(IP3 – P_{IN}), where P_{IN} = input RF/carrier for two carriers.

Typical L-Band Performance

Table 5. L-Band Interfacility Link Specifications: 8710ATx and 8720A (6 dB Optical Loss Budget)

Parameter	Symbol	Input Amp		Fiber-Optic Link	Output Amp		System (without RSU)		Unit
		Min	Max	Typ	Min	Max	Min	Max	
Gain	G	15	30	–22	0	15	–7	23	dB
Noise Figure	NF	17	8	48	13	7	34	19	dB
Output TOI	—	28	31	8	16	27	3	19	dBm

C-Band, Extended C-Band, X-Band, and Ku-Band Interfacility Link Specifications

These links carry the main transmit and receive signals between the equipment room and the antenna site. Each fiber-optic path carries one entire polarization. One fiber is used in single strand links and two are used in 1:1 redundant paths. Or, the path may share a fiber-optic link with another path in 1:2 redundant configurations. Each link is designed to meet and exceed all of the requirements for use in Intelsat Standard A earth stations, even under conditions of heaviest signal loading.

Typical C-Band Performance

Table 6. C-, Extended C-, X-, and Ku-Band Interfacility Link Specifications: Uplink Path, 8810A Tx/8820A Rx;
Downlink Path, 8810B Tx/8820B Rx

Parameter	Specification				
	Symbol	Min	Typ	Max	Unit
Passband:	—				
8810A Tx/8820A Rx		5.845	—	6.425	GHz
8810A-E08 Tx/8820A-E03		5.845	—	6.725	GHz
8810B Tx/8820B Rx		3.6	—	4.2	GHz
8810B-E05 Tx/8820B-E06		3.4	—	4.2	GHz
Optical Loss Budget:	L_{OPT}				
1310 nm		—	6	—	dB
1550 nm		—	12	—	dB
Nominal RF Input at Max Input Gain:	RF_{IN}				
8810A Tx/8820A Rx		—	–15	—	dBm
8810B Tx/8820B Rx		—	–30	—	dBm
Link Gain (–6 dB With Redundancy Switching):	G				
8810A Tx/8820A Rx		–13	—	7	dB
8810B Tx/8820B Rx		–11	—	14	dB
Flatness	—	—	±0.2/48	—	dB/MHz
		—	±0.7/500	—	dB/MHz
Gain Slope	—	—	0.02	—	dB/MHz
Gain Stability at Constant Temperature	ΔG_T	—	±0.15/24	—	dB/hr
Noise Figure at Max Input Gain (Add 4 dB with Redundancy Switching):	NF				
8810A Tx/8820A Rx		—	32	—	dB
8810B Tx/8820B Rx		—	20	—	dB
Spur-Free Dynamic Range:*	SDFR				
8810A Tx/8820A Rx		—	98	—	$dB/Hz^{2/3}$
8810B Tx/8820B Rx		—	96	—	$dB/Hz^{2/3}$
Group Delay:	—				
Peak-to-Peak		—	0.5	—	ns
Linear		—	0.02	—	ns/MHz
Parabolic		—	0.01	—	ns/MHz^2
Input/Output Impedance	Z	—	50	—	Ω
Input/Output VSWR	—	—	1.35:1	—	—

* Spur-free dynamic range (SFDR) = $2/3(IP3 – NF + 173.8)$ $dB/Hz^{2/3}$; IP3 = input third-order intercept, NF = noise figure. SFDR is the range where the carrier is above the noise and the third IM is below the noise, $C/I = 2x(IP3 – P_{IN})$, where P_{IN} = input RF/carrier for two carriers.

C-Band, Extended C-Band, X-Band, and Ku-Band Interfacility Link Specifications
(continued)

Typical C-Band Performance (continued)

Table 6. C-, Extended C-, X-, and Ku-Band Interfacility Link Specifications: Uplink Path, 8810A Tx/8820A Rx;
Downlink Path, 8810B Tx/8820B Rx (continued)

Parameter	Specification				
RF Connector	—	N Jack			—
	Symbol	**Min**	**Typ†**	**Max**	**Unit**
Optical Wavelength:	λ				—
8810A Tx/8820A Rx		—	1310	—	nm
8810A-E08 Tx/8820A-E03		—	1310	—	nm
8810B Tx/8820B Rx		—	1310	—	nm
8810B-E05 Tx/8820B-E06		—	1310	—	nm
8810A-E03 Tx/8820A Rx		—	1550	—	nm
8810A-E03 Tx/8820A-E03		—	1550	—	nm
8810B-E04 Tx/8820B Rx		—	1550	—	nm
8810B-E04 Tx/8820B-E06		—	1550	—	nm
Optical Connector	—	FC/APC (Tight-fit Keying), Return Loss > 60			— dB
Absolute Maximum RF Input (Max Input Gain):	$RF_{IN\ MAX}$				
8810A Tx/8820A Rx		—	—	5	dBm
8810B Tx/8820B Rx		—	—	–10	dBm

* Spur-free dynamic range (SFDR) = 2/3(IP3 – NF + 173.8) dB/$Hz^{2/3}$; IP3 = input third-order intercept, NF = noise figure. SFDR is the range where the carrier is above the noise and the third IM is below the noise, C/I = 2x(IP3 – P_{IN}), where P_{IN} = input RF/carrier for two carriers.
† Single-mode fiber.

Table 7. C-Band Uplink Specifications: 8810A Tx and 8720A Rx (6 dB Optical Loss Budget)

Parameter	Symbol	Input Amp		Fiber-Optic Link	Output Amp		System (without RSU)		Unit
		Min	**Max**	**Typ**	**Min**	**Max**	**Min**	**Max**	
Gain	G	3	13	–23	7	17	–13	7	dB
Noise Figure	NF	23	15	43	16	10	42	31	dB
Output TOI	—	24	24	1	20	24	5	14	dB

Table 8. C-Band Downlink Specifications: 8810B Tx and 8820B Rx (6 dB Optical Loss Budget)

Parameter	Symbol	Input Amp		Fiber-Optic Link	Output Amp		System (without RSU)		Unit
		Min	**Max**	**Typ**	**Min**	**Max**	**Min**	**Max**	
Gain	G	12	27	–23	0	10	–11	14	dB
Noise Figure	NF	26	14	43	16	10	34	19	dB
Output TOI	—	24	24	1	14	207	–2	7	dB

C-Band, Extended C-Band, X-Band, and Ku-Band Interfacility Link Specifications
(continued)

Typical C-Band Performance (continued)

Table 9. Sample Link Analysis: Downlink GT

Parameter	Specification	Unit
Frequency	4.0	GHz
Total Power Flux Density	–117.3	dBW/m^2
Antenna Diameter	18	m
Antenna Efficiency	74	%
Antenna Temperature	65	°K
Feed Loss	0.15	dB
LNA Gain	50	dB
LNA Temperature	35	°K
Cable Loss into IFL	4	dB
Total Power into IFL	–20.5	dBm
Fiber-optic IFL Gain	5.2	dBm
Fiber-optic IFL Noise Figure	26.4	dB
IFL Two-Tone Third IM	–51.4	dBc
Output Loss (Splitter)	12	dB
Downconverter Input Channel	–39.2	dBm
Downconverter Noise Figure	17	dB
System G/T	34.32	dB/°K
G/T Without Fiber-optic IFL	34.43	dB/°K

Table 10. Sample Link Analysis: Fiber-Optic IFL Contribution to Uplink Path EIRP

Parameter	Specification	Unit
Frequency	6.0	GHz
Number of Channels	4	—
Channel Noise Bandwidth	32	MHz
IFL RF Input/Channel	–15	dBm
Fiber-optic IFL Gain	3.4	dBm
Fiber-optic IFL Noise Figure	34	dB
IFL Output IP3	13	dBm
Cable Loss	8.0	dB
Antenna Diameter	18	m
Antenna Gain	59.6	dB
EIRP/Channel	88	dBW
Noise EIRP	–1.2	dBW/4 kHz
IM EIRP	5.4	dBW/4 kHz

C-Band, Extended C-Band, X-Band, and Ku-Band Interfacility Link Specifications
(continued)

Typical X-Band Performance (continued)

Table 11. X-Band Interfacility Link Specifications: 8850A Tx and 8860A Rx

Parameter	Specification				
	Symbol	Min	Typ	Max	Unit
Passband	—	7.25	—	8.40	GHz
Optical Loss Budget	L_{OPT}	—	6	—	dB
Nominal RF Input at Max Input Gain	RF_{IN}	—	–30	—	dBm
Link Gain (–6 dB with Redundancy Switching)	G	–9	—	11	dB
Flatness	—	— —	±0.25 /48 ±0.75/500	— —	dB/MHz dB/MHz
Gain Slope	—	—	≤0.02	—	dB/MHz
Gain Stability at Constant Temperature	ΔG_T	—	±0.15/24	—	dB/hr
Noise Figure at Max Input Gain (Add 4 dB with Redundancy Switching)	NF	—	26	—	dB
Spur-Free Dynamic Range*	SDFR	—	92	—	$dB/Hz^{2/3}$
Group Delay: Peak-to-Peak Linear Parabolic	—	 — — —	 0.5 0.02 0.01	 — — —	 ns ns/MHz ns/MHz^2
Input/Output Impedance	Z	—	50	—	Ω
Input/Output VSWR	—	—	1.35:1	—	—
RF Connector	—	N Jack			—
Optical Fiber	—	1310 nm, single mode			—
Optical Connector	—	FC/APC (Tight-fit Keying), Return Loss > 60			— dB
Absolute Maximum RF Input (Max Input Gain)	$RF_{IN\ MAX}$	—	—	–15	dBm

* Spur-free dynamic range (SFDR) = 2/3(IP3 – NF + 173.8) $dB/Hz^{2/3}$; IP3 = input third-order intercept, NF = noise figure. SFDR is the range where the carrier is above the noise and the third IM is below the noise, C/I = 2x(IP3 – P_{IN}), where P_{IN} = input RF/carrier for two carriers.

C-Band, Extended C-Band, X-Band, and Ku-Band Interfacility Link Specifications
(continued)

Typical X-Band Performance (continued)

Table 12. X-Band Specifications: 8850A Tx and 8860A Rx (6 dB Optical Loss Budget)

Parameter	Symbol	Input Amp		Fiber-Optic Link	Output Amp		System (without RSU)		Unit
		Min	Max	Typ	Min	Max	Min	Max	
Gain	G	20	30	–43	8	18	–15	5	dB
Noise Figure	NF	18	10	55	8	6	36	26	dB
Output TOI	—	26	25	–18	15	21	–7	–2	dB

Table 13. Sample Link Analysis: Downlink GT

Parameter	Specification	Unit
Frequency	7.75	GHz
Total Power Flux Density	–120	dBW/m^2
Antenna Diameter	11.6	m
Antenna Efficiency	70	%
Antenna Temperature	30	°K
Feed Loss	0.2	dB
LNA Gain	50	dB
LNA Temperature	50	°K
Cable Loss into IFL	6	dB
Total Power into IFL	–2.9	dBm
Fiber-optic IFL Gain	11.5	dBm
Fiber-optic IFL Noise Figure	25.1	dB
IFL Two-Tone Third IM	–44.1	dBc
Output Loss (Splitter)	NA	—
Downconverter Input Channel	–28.3	dBm
Downconverter Noise Figure	17	dB
System G/T	37.37	dB/°K
G/T Without Fiber-optic IFL	37.53	dB/°K

C-Band, Extended C-Band, X-Band, and Ku-Band Interfacility Link Specifications
(continued)

Typical Ku-Band Performance (continued)

Table 14. Ku-Band Interfacility Link Specifications: Uplink Path, 8910A Tx/ 8920A Rx; Downlink Path, 8910B Tx/ 8920B Rx

Parameter	Specification				
	Symbol	Min	Typ	Max	Unit
Passband:	—				
Uplink,8910A Tx/8920A Rx		14.0	—	14.5	GHz
Downlink,8910B Tx/8920B Rx		10.95	—	12.75	GHz
Downlink,8910B-E01 Tx/8920B-E01 Rx		10.7	—	12.75	GHz
Optical Loss Budget	L_{OPT}	—	6	—	dB
Nominal RF Input at Max Input Gain:	RF_{IN}				
8910A Tx/8920A Rx		—	–30	—	dBm
8910B Tx/8920B Rx		—	–30	—	dBm
Link Gain (–6 dB with Redundancy Switching):	G				
8910A Tx/8920A Rx		–9	—	11	dB
8910B Tx/8920B Rx		–16	—	11	dB
Flatness	—	—	±0.2/48	—	dB/MHz
		—	±0.7/500	—	dB/MHz
Gain Slope	—	—	0.02	—	dB/MHz
Gain Stability at Constant Temperature	ΔG_T	—	±0.15/24	—	dB/hr
Noise Figure at Max Input Gain (Add 4 dB with Redundancy Switching):	NF				
8910A Tx/8920A Rx		—	25	—	dB
8910B Tx/8920B Rx		—	25	—	dB
Spur-Free Dynamic Range:*	SDFR				
8910A Tx/8920A Rx		—	94	—	$dB/Hz^{2/3}$
8910B Tx/8920B Rx		—	94	—	$dB/Hz^{2/3}$
Group Delay:	—				
Peak-to-Peak		—	0.5	—	ns
Linear		—	0.02	—	ns/MHz
Parabolic		—	0.01	—	ns/MHz^2
Input/Output Impedance	Z	—	50	—	Ω
Input/Output VSWR	—	—	1.35:1	—	—
RF Connector	—	SMA			—
Optical Fiber	—	1310 nm, Single Mode			—
Optical Connector	—	FC/APC (Tight-fit Keying), Return Loss > 60			— dB
Absolute Maximum RF Input (Max Input Gain)	$RF_{IN\ MAX}$	—	—	–15	dBm

* Spur-free dynamic range (SFDR) = $2/3(IP3 – NF + 173.8)\ dB/Hz^{2/3}$; IP3 = input third-order intercept, NF = noise figure. SFDR is the range where the carrier is above the noise and the third IM is below the noise, $C/I = 2x(IP3 – P_{IN})$, where P_{IN} = input RF/carrier for two carriers.

C-Band, Extended C-Band, X-Band, and Ku-Band Interfacility Link Specifications
(continued)

Typical Ku-Band Performance (continued))

Table 15. Ku-Band Interfacility Link Specifications: Uplink Path, 8910A Tx/ 8920A Rx (6 dB Optical Loss Budget)

Parameter	Symbol	Input Amp		Fiber-Optic Link	Output Amp		System (without RSU)		Unit
		Min	Max	Typ	Min	Max	Min	Max	
Gain	G	20	30	–37	8	18	–9	11	dB
Noise Figure	NF	18	10	55	8	6	36	25	dB
Output TOI	—	26	25	–8	15	21	–5	4	dB

Table 16. Ku-Band Interfacility Link Specifications: Uplink Path, 8910B Tx/ 8920B Rx (6 dB Optical Loss Budget)

Parameter	Symbol	Input Amp		Fiber-Optic Link	Output Amp		System (without RSU)		Unit
		Min	Max	Typ	Min	Max	Min	Max	
Gain	G	15	30	–37	8	18	–14	11	dB
Noise Figure	NF	22	10	55	8	6	42	25	dB
Output TOI	—	26	25	–8	15	21	–5	4	dB

Table 17. Sample Link Analysis: Downlink G/T

Parameter	Specification	Unit
Frequency	11.2	GHz
Total Power Flux Density	–116	dBW/m^2
Antenna Diameter	10	m
Antenna Efficiency	74	%
Antenna Temperature	48	°K
Feed Loss	0.15	dB
LNA Gain	50	dB
LNA Temperature	70	°K
Cable Loss into IFL	3	dB
Total Power into IFL	–22.7	dBm
Fiber-optic IFL Gain	5.9	dBm
Fiber-optic IFL Noise Figure	30.4	dB
IFL Two-Tone Third IM	–51.0	dBc
Output Loss (Splitter)	8	dB
Downconverter Input Channel	–27.8	dBm
Downconverter Noise Figure	17	dB
System G/T	37.9	dB/°K
G/T without Fiber-optic IFL	38.1	dB/°K

Table 18. Sample Link Analysis: Fiber-Optic IFL Contribution to Uplink Path EIRP

Parameter	Specification	Unit
Frequency	14.0	GHz
Number of Channels	4	—
Channel Noise Bandwidth	32	MHz
IFL RF Input/Channel	–25	dBm
Fiber-optic IFL Gain	5.3	dBm
Fiber-optic IFL Noise Figure	31.0	dB
IFL Output IP3	5.7	dBm
Cable Loss	8.0	dB
HPA Gain	77.0	dB
Antenna Diameter	11	m
Antenna Gain	62.6	dB
EIRP/Channel	82	dBW
Noise EIRP	0.0	dBW/4 kHz
IM EIRP	–0.6	dBW/4 kHz

Remote RF Signal Monitor Interfacility Link Specifications

These links bring the uplink RF test ports located at the antenna site back to the equipment room or control room. This permits the operator to monitor the composite transmitted RF signals conveniently, quickly, and reliably without having to go to the antenna site or invest in a spectrum analyzer for every antenna site. In applications where the system 8000 is being used for the main signal paths, these links can be included as plug-ins in the main chassis. Or, the uplink RF monitor links can be added to an existing earth station with all the output ports in one chassis in the control room.

Table 19. RF Signal Monitor Interfacility Link Specifications: C-Band, 8483A Tx; Ku-Band 8493A Tx

Parameter	Specification				
	Symbol	Min	Typ	Max	Unit
Passband: C-Band, 8483A Tx Ku-Band 8493A Tx	— 	 5.845 14.0	 — —	 6.725 14.5	 GHz GHz
Optical Loss Budget	L_{OPT}	—	6	—	dB
Nominal Input Power	P_{IN}	—	5	—	dBm
Link Loss:* C-Band, 8483A Tx Ku-Band, 8493A Tx	L_L 	 10 15	 — —	 20 25	 dB dB
Flatness	—	— —	±0.2/48 ±0.7/500	— —	dB/MHz dB/MHz
Gain Slope	—	—	0.02	—	dB/MHz
Gain Stability at Constant Temperature	ΔG_T	—	±0.15/24	—	dB/hr
Noise Figure: C-Band, 8483A Tx Ku-Band, 8493A Tx	NF 	 — —	 48 55	 — —	 dB dB
Linearity Input IP3: C-Band, 8483A Tx Ku-Band, 8493A Tx Input 1 dB Compression Point: C-Band, 8483A Tx Ku-Band, 8493A Tx	—	 — — — —	 30 28 18 18	 — — — —	 dBm dBm dBm dBm
Group Delay: Peak-to-Peak Linear Parabolic	—	 — — —	 0.5 0.02 0.01	 — — —	 ns ns/MHz ns/MHz^2
Input/Output Impedance	Z	—	50	—	Ω
Input/Output VSWR	—	—	1.35:1	—	—
RF Connector: C-Band, 8483A Tx Ku-Band 8493A Tx	—	 N Jack SMA Jack			 — —
Optical Fiber	—	1310 nm, Single Mode			—
Optical Connector	—	FC/APC (Tight-fit Keying), Return Loss > 60			— dB
Absolute Maximum RF Input (Max Input Gain)	$RF_{IN\ MAX}$	—	—	–18	dBm

*Adjustable at output.

Fiber-Optic Data Link Specifications

These plug-ins can be added to the System 8000 chassis to provide a full duplex data path connecting the M and C computer terminals at the antenna site and the equipment room. The standard version is for RS-422 serial data with an option for RS-232. This link provides a data path only; there is no hand shaking, so a modem must be used at each computer.

Table 20. Fiber-optic Data Link Specifications: 8501A Tx and Transceiver

18501A			Transceiver		
Parameter	**Specification**	**Unit**	**Parameter**	**Specification**	**Unit**
Bit Error Rate	$\leq 10^{-9}$	—	Optical Connector	FC/APC, 1310 nm, single mode	—
Operating Mode	Asynchronous, Full Duplex	—	Optical Loss Budget	6	dB
Data Rate: RS-422 RS-232	 200 19.2	 kbits/s kbits/s	I/O Logic Levels Standard	RS-422A: Balanced/Terminated, 120 Ω Differential I/O Range: V_{MIN} ±1 to V_{MAX} ±6 RS-232: Single-ended, Unbalanced, Nonterminated; I/O Range: V_{MIN} ± 4 to V_{MAX} ± 12	 V — V
Connector (Chassis Rear Panel)	DB-9S	—			
Transmitter Optical Output Power	>0.5	mW			

System 8000 Redundancy

System 8000 provides multiple redundancy options. The standard offerings are single thread, 1:1, and 1:2. The 1:1 and 1:2 configurations offer two modes of redundancy switching: automatic and manual.

Automatic Mode

In this mode, internal sensing and control provides automatic switching to the backup link in case of any failure in the optical system. If the laser temperature alarm or laser optical power alarm is detected at the fiber-optic transmitter, the faulty transmitter is shut off. In the 1:2 redundancy scheme, if these conditions are detected, the switch position is changed to select the backup link. The fiber-optic receiver then detects loss of received optical power and the output is switched to the backup link. If the fiber-optic cable containing the fiber for the primary link is broken, the fiber-optic receiver detects loss of received optical power and the output is switched to the other channel. The switching due to receiver failure works independently of the external monitoring and control (M and C) system only for the 1:1 configuration. For the 1:2 version, the external M and C must switch the input to the backup transmitter.

Manual Mode

When this mode is selected, automatic switching to the backup link is turned off. This mode can be selected remotely through the M and C system or it can be selected locally by pressing the auto-off button on the front panel of the status and control plug-in on the chassis.

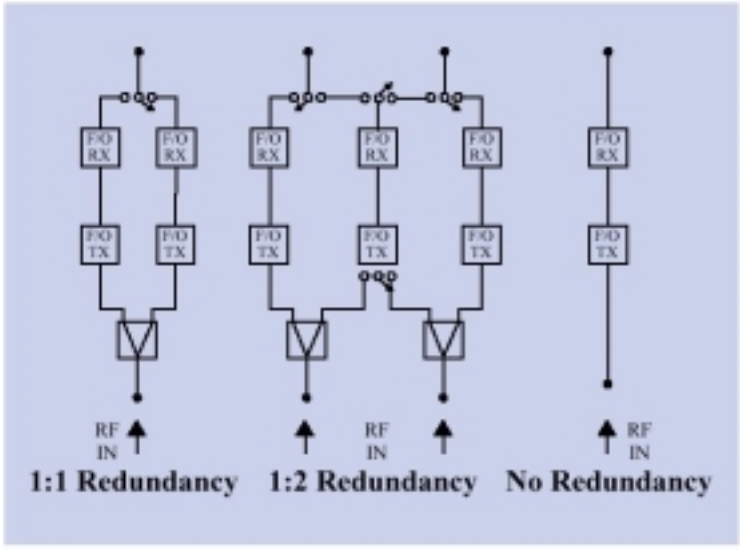


Figure 1. System 8000 Redundancy Mode Configurations

General Specifications

Alarms and Warnings

Alarms and warnings are indicated on the plug-in front panel by LED annunciators. Alarms are displayed in red, warnings in yellow. Both alarms and warnings are reported to the remote interface.

Power supply faults are indicated on the front panel by red annunciators and are reported to the remote interface. The chassis configuration is continuously reported to the remote interface.

Table 21. Alarms and Warnings Descriptions

Transmitter Plug-ins	Annunciator Readout	Color
	Power On	Green (normally on)
	Opt Pwr Lo	Red
	Laser Temp	Red
	RF Pwr Lo	Yellow
Receiver Plug-ins	Power On	Green (normally on)
	Opt Pwr Lo	Red
	Output Pwr Hi	Yellow
	RF Pwr Lo	Yellow

Power Requirements

Table 22. Power requirements

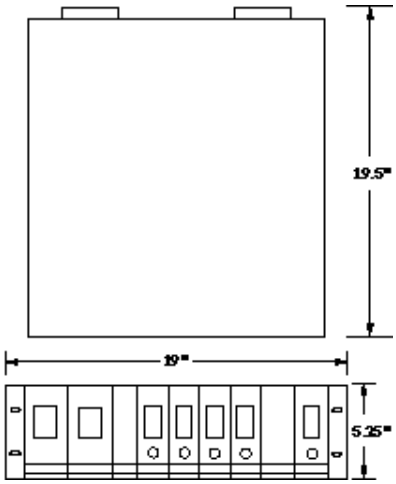
System/Component	Specification	Unit
8001A Chassis with 8010A (Factory Set)	115/230, 50—60	Vac, Hz
Status and Control Plug-in	5	W
Transmitter Plug-in	18	W
Receiver Plug-in	5.2	W

General Dimensions

Table 23. General Dimensions

Parameter	Specification
Weight:	
8000A Chassis (includes two power supplies and status and control)	27 lbs. net; 30 lbs, shipping
Transmitter and Receiver Plug-in	3 lbs. net; 4 lbs. shipping
Dimensions:	
Standard Rack-mountable	19 in. W x 5.25 H x 19.5 in. D (48.26 cm W x 13.34 cm H x 49.53 cm D)

Outline Diagram



Laser Safety Information

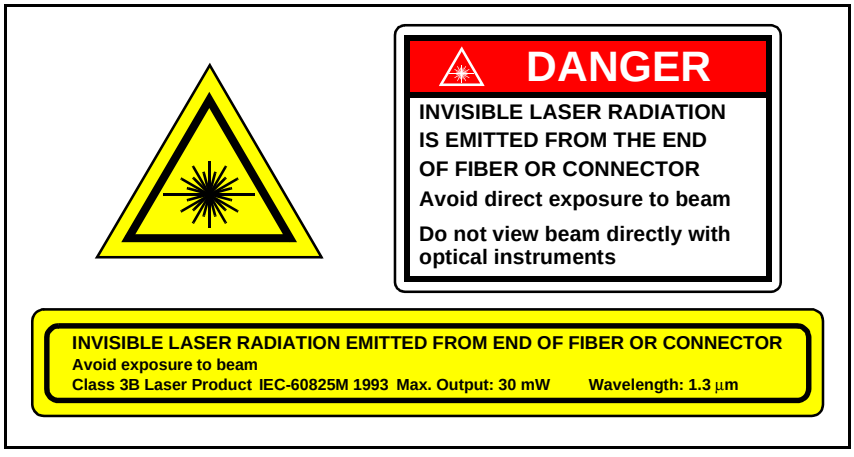
Class IIIb Laser Product

FDA/CDRH Class IIIb laser product. All transmitter versions are Class IIIb laser products per CDRH, 21 CFR 1040 Laser Safety requirements. All transmitter versions are Class 3B laser products per *IEC** 60825-1:1993. The devices have been classified with the FDA under an accession number to be determined.

This product complies with 21 CFR 1040.10 and 1040.11.
Wavelength = 1.3 μm.
Maximum power = 30 mW.

Caution: **Use of controls, adjustments, and procedures other than those specified herein may result in hazardous laser radiation exposure.**

* *IEC* is a registered trademark of The International Electrotechnical Commission.



Ordering Information

Table 24. Ordering Information

Device	Description	Model Number
System 8000:	Mainframe	8000A
Chassis	—	8001A
Main Power Supply	—	8009A
Standby Power Supply	—	8009B
Status and Control RS232 or RS485	—	8010B-RS232 or RS485
Accessory Kit	Includes 6 dB optical attenuators, installation software, and optical connector cleaning kit (other attenuation values available upon request)	8050A, 6 dB
Ku-Band, 8900 Series:		
Uplink Transmitter	14.0 GHz—14.5 GHz	8910A
Uplink Receiver	14.0 GHz—14.5 GHz	8920A
Downlink Transmitter	10.7 GHz—12.75 GHz	8910B
Downlink Receiver	10.7 GHz—12.75 GHz	8920B
X-Band, 8800 Series:		
Transmitter	7.25 GHz—8.4 GHz	8850A
Receiver	7.25 GHz—8.4 GHz	8860A
C-Band, 8800 Series:		
Uplink Transmitter	5.485 GHz—6.725 GHz	8810A
Uplink Receiver	5.485 GHz—6.725 GHz	8820A
Downlink Transmitter	3.4 GHz—4.2 GHz	8810B
Downlink Receiver	3.4 GHz—4.2 GHz	8820B
L-Band, 8700 Series:		
Transmitter (Uplink and Downlink)	950 MHz—2050 MHz	8710A
Receiver (Uplink and Downlink)	950 MHz—2050 MHz	8720A
70 MHZ—140 MHz, 8600 Series:		
70/140 MHz Transmitter:	75 Ω	8603A
High Performance	10 km—40 km	Option 001
High Performance	40 km—70 km	Option 002
75 Ω	—	Option 050
70/140 MH Receiver:	75 Ω	8604A
High Gain	—	Option 001
Low Gain	—	Option 002
50 Ω	—	Option 050
Remote RF Signal Monitor, 8400 Series:		
Ku-band Signal Monitor Tx (Use with Standard Ku-band Uplink Receiver)	14.0 GHz—14.5 GHz	8493A
C-band Signal Monitor Tx 8483a (Use With Standard C-band Uplink Receiver)	5.485 GHz—6.425 GHz	8483A
Fiber-optic Data Link:		
RS-422, Standard	—	8501A
RS-232, Optional	—	Option 001

Related Documentation

Table 25. Related Documentation

Description	Document Number
System 8000 Fiber-Optic Interfacility Links Application Note	AP01-003OPTO