ICS-75

Integrated Combiner Shelf
Installation and Operation Manual

Part Number MN/ICS75.IOM
Revision 4

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ICS-75

Integrated Combiner Shelf Installation and Operation Manual

Part Number MN/ICS75.IOM
Revision 4
November 11, 1998

Special Instructions:

Change bars were not utilized. For an overview of changes made to Rev. 3, refer to the preface ("Overview of Changes to Previous Edition").

This revision supersedes part number MN/ICS75.IOM, Rev. 3 dated November 22, 1995.

Comtech EF Data Corporation, 2114 West 7th Street, Tempe, Arizona 85281 USA, (480) 333-2200, FAX: (480) 333-2161.

Warranty Policy

This Comtech EF Data product is warranted against defects in material and workmanship for a period of one year from the date of shipment. During the warranty period, Comtech EF Data will, at its option, repair or replace products that prove to be defective.

For equipment under warranty, the customer is responsible for freight to Comtech EF Data and all related custom, taxes, tariffs, insurance, etc. Comtech EF Data is responsible for the freight charges only for return of the equipment from the factory to the customer. Comtech EF Data will return the equipment by the same method (i.e., Air, Express, Surface) as the equipment was sent to Comtech EF Data.

Limitations of Warranty

The foregoing warranty shall not apply to defects resulting from improper installation or maintenance, abuse, unauthorized modification, or operation outside of environmental specifications for the product, or, for damages that occur due to improper repackaging of equipment for return to Comtech EF Data.

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Comtech EF Data has reviewed this manual thoroughly in order that it will be an easy-to-use guide to your equipment. All statements, technical information, and recommendations in this manual and in any guides or related documents are believed reliable, but the accuracy and completeness thereof are not guaranteed or warranted, and they are not intended to be, nor should they be understood to be, representations or warranties concerning the products described. Further, Comtech EF Data reserves the right to make changes in the specifications of the products described in this manual at any time without notice and without obligation to notify any person of such changes.

If you have any questions regarding your equipment or the information in this manual, please contact the Comtech EF Data Customer Support Department. (For more information, refer to the preface.)

Preface

About this Manual

This manual provides installation and operation information for the ICS-75 Integrated Combiner Shelf. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the ICS-75.

Conventions and References Used in this Manual

Cautions and Warnings

CAUTION indicates a hazardous situation that, if not avoided, may result in minor or moderate injury. CAUTION may also be used to indicate other unsafe practices or risks of property damage.

WARNING indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

Metric Conversion

Metric conversion information is located on the inside back cover of this manual. This information is provided to assist the operator in cross-referencing English to Metric conversions.

Recommended Standard Designations

Recommended Standard (RS) Designations have been superseded by the new designation of the Electronic Industries Association (EIA). References to the old designations are shown only when depicting actual text displayed on the screen of the unit (RS-232, RS-485, etc.). All other references in the manual will be shown with the EIA designations (EIA-232, EIA-485, etc.) only.

Trademarks

Other product names mentioned in this manual may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

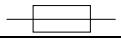
European EMC Directive

In order to meet the European Electro-Magnetic Compatibility (EMC) Directive (EN55022, EN50082-1), properly shielded cables for DATA I/O are required. More specifically, these cables must be double-shielded from end-to-end, ensuring a continuous ground shield.

The following information is applicable for the European Low Voltage Directive (EN60950):

<HAR>	Type of power cord required for use in the European Community.
	CAUTION: Double-pole/Neutral Fusing ACHTUNG: Zweipolige bzw. Neutralleiter-Sicherung

International Symbols:

	Alternating Current.
	Fuse.
	Safety Ground.
	Chassis Ground.

Note: For additional symbols, refer to “Cautions and Warnings” listed earlier in this preface.

Overview of Changes to Previous Edition

A summary of the changes made to Rev. 3 includes:

- Incorporated various cosmetic (non-technical) changes (e.g., formatting, spelling)
- Updated loss specifications (Chapter 1)

Reporting Comments Concerning this Manual

Comments and suggestions regarding the content and design of this manual will be appreciated. To submit comments, please contact the Comtech EF Data Customer Support Department according to the following information.

Customer Support

Contact the Comtech EF Data Customer Support Department for:

- Product support
- Information on returning a product
- Information on upgrading a product
- Product training
- Reporting comments or suggestions concerning manuals

A Customer Support representative may be reached at:

Comtech EF Data
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2114 West 7th Street
Tempe, Arizona 85281 USA

(480) 333-2200 (Main Number)
(480) 333-4357 (Customer Support Desk)
(480) 333-2161 FAX

or, E-Mail can be sent to the Customer Support Department at:

service@comtechefdata.com

To return a Comtech EF Data product (in-warranty and out-of-warranty) for repair or replacement:

1. Request a Return Material Authorization (RMA) number from the Customer Support Department.

   Be prepared to supply the Customer Support representative with the model number, serial number, and a description of the problem.

2. To ensure that the product is not damaged during shipping, pack the product in its original shipping carton/packaging.

3. Ship the product back to Comtech EF Data. (Shipping charges should be prepaid.)

For more information regarding the warranty policies, refer to the disclaimer page located behind the title page.

Table of Contents

Figures

Tables

Chapter 1. INTRODUCTION

This chapter describes the specifications for the Comtech EF Data ICS-75 integrated combiner shelf (Figure 1-1).

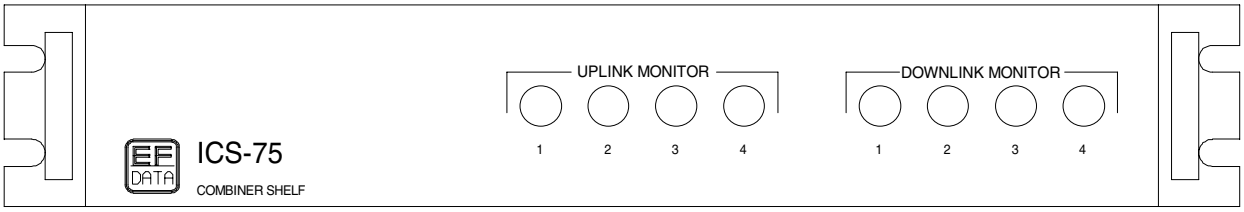

Figure 1-1. ICS-75

1.1 Purpose and Function

The ICS-75 was designed to be used as a 4-channel combiner and 4-channel splitter for IF frequencies between 50 MHz and 180 MHz.

Each uplink channel may optionally have four, six, or eight inputs.

Each downlink channel may optionally have four, six, or eight outputs. The fourth downlink channel may also optionally have 10 outputs.

The input and output impedances normally are 75Ω, but a 50Ω option is available.

Each channel has a monitor port available to sample the combined port.

Refer to Figure 1-2 for a block diagram of the combiner shelf.

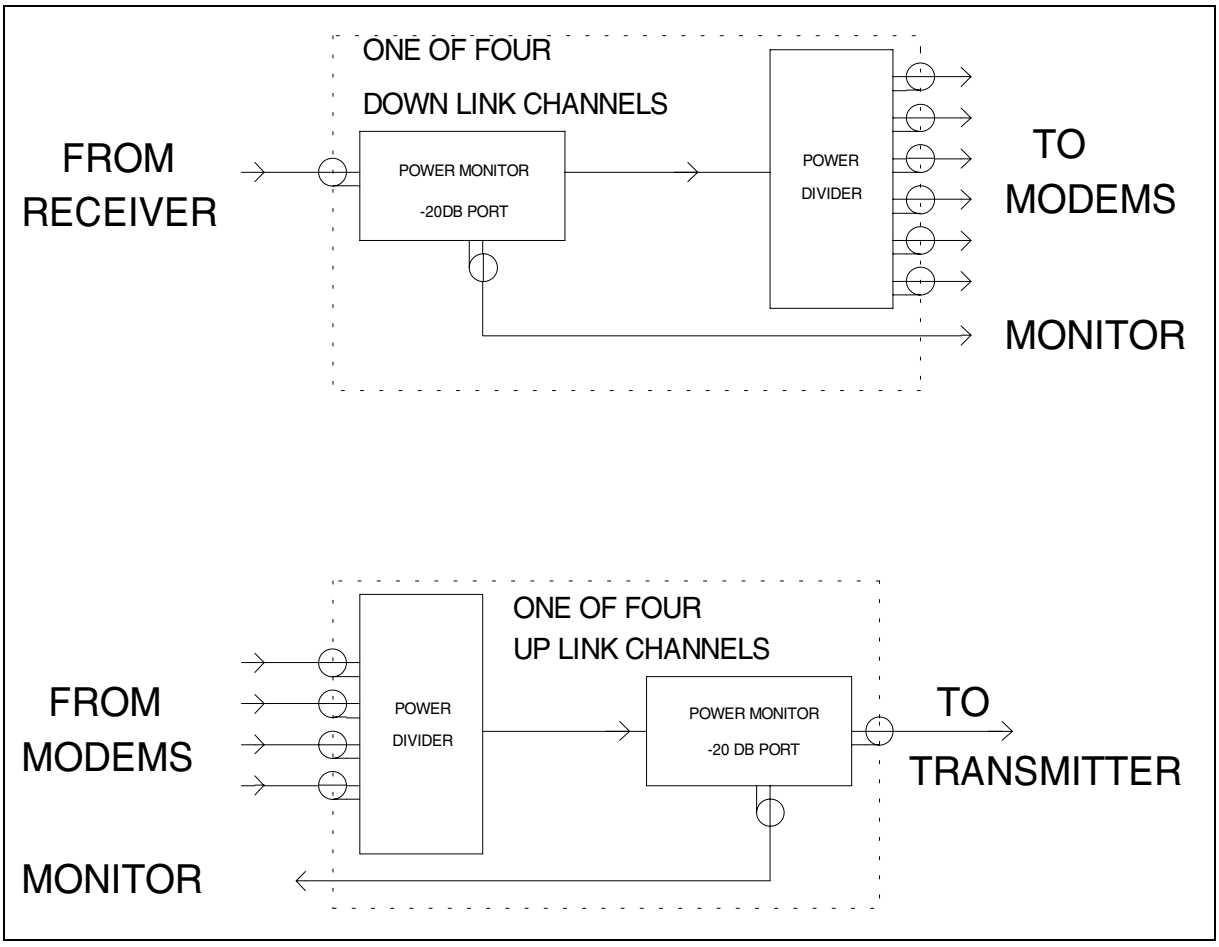

Figure 1-2. ICS-75 Block Diagram

1.2 Description

The ICS-75 is housed in a 19” rack-mountable chassis, 3.5” (2U) high.

All inputs and outputs are located on the chassis rear panel, and the monitor ports are located on the front panel.

Since the combiner shelf is composed entirely of passive components, no power inputs are required.

1.3 Specifications

Table 1-1. ICS-75 Specifications

Frequency Range	50 to 180 MHz.
Uplinks	Configurable for 1 to 4 uplinks, with options for 4, 6, or 8 inputs.
Downlinks	Configurable for 1 to 4 downlinks, with options for 3 of the downlinks to have 4, 6, or 8 outputs, and the fourth downlink to have 4, 6, 8, or 10 outputs.
Impedance	All Ports — 75Ω (50Ω optional).
Return Loss (Inputs and Outputs)	20 dB minimum.
IF Loss by Number of Channel Ports	
4 Ports:	<7.2 dB
6 Ports:	<9.2 dB
8 Ports:	<10.5 dB
10 Ports:	<12.5 dB
Flatness	± 0.25 over 20 MHz.
Monitor Coupling Loss	20 dB ± 0.5 dB.
Return Loss Monitor Ports	20 dB Minimum. (both 50Ω and 75Ω)
Connectors	BNC Female.
Physical Size	3.5” by 22” by 19” rack. (8.89 cm x 55.88 cm x 48.26 cm)
Weight	10 lbs. Max. (4.54 kg)

2 Chapter 2 INSTALLATION

2.1 Unpacking

The unit and manual are packaged in preformed reusable foam inside a cardboard carton.

To remove the unit, proceed as follows:

Do not use any cutting tool that will extend more than 1" into the container and cause damage to the unit.

1. Cut the tape at the top of the carton (indicated by OPEN THIS END).
2. Remove the cardboard/foam space covering the switch.
3. Lift out the switch and manual.
4. Save the packing material for storage or reshipment purposes.
5. Inspect the equipment for possible damage incurred during shipment.
6. Check the equipment against the packing list to ensure the shipment is correct.

2.2 System Installation

After unpacking the unit per Section 2.1, install the unit as follows:

1. Mount the ICS-75 chassis in the assigned position in the equipment rack.
2. Connect the cables to the appropriate locations on the rear panel.
3. Refer to Section 2.3 for connector pinouts, placement, and function.
4. Refer to Figure 2-1 for an interconnect diagram of a typical installation.
5. All unused connectors must be terminated with 75Ω (50Ω for the 50Ω option).
6. If there is any problem with the installation, refer to Chapter 4 for troubleshooting.

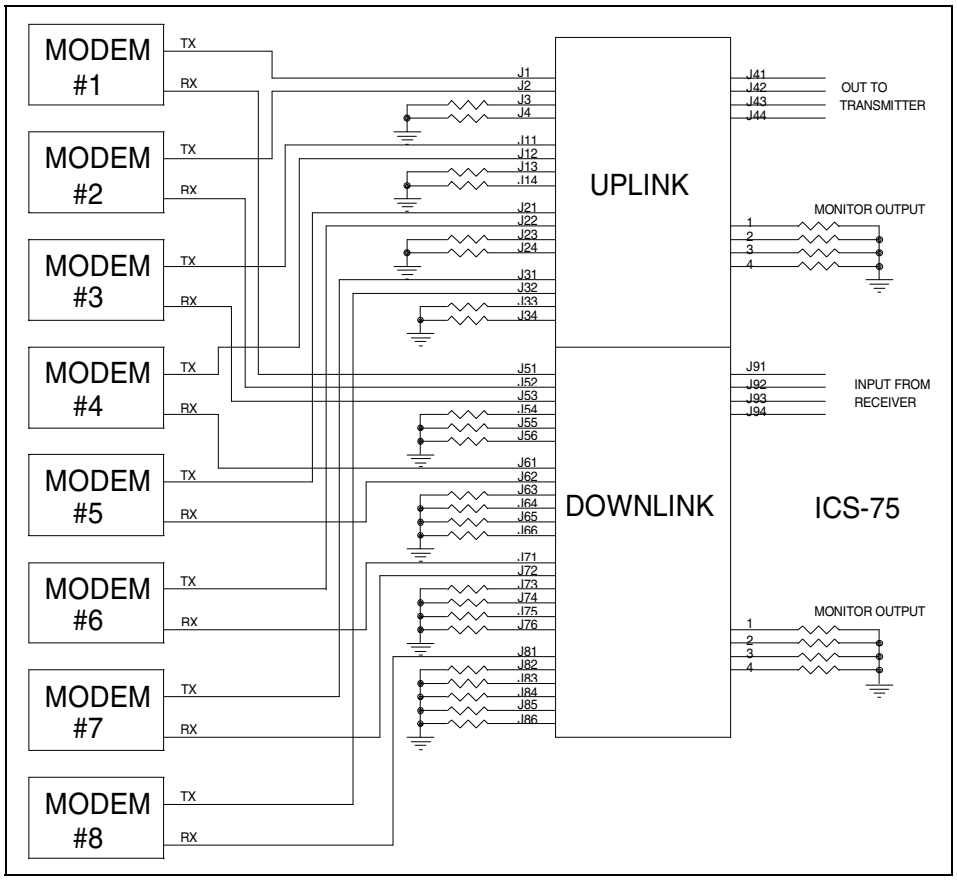

Figure 2-1. Typical Interconnect Diagram

2.3 External Connections

Connections between the ICS-75 and other equipment are made through BNC connectors. These connectors are listed in Table 2-1 and Table 2-2.

Refer to Chapter 1 for the locations of the front panel connectors.

Refer to Figure 2-2 for the locations of the rear panel connectors.

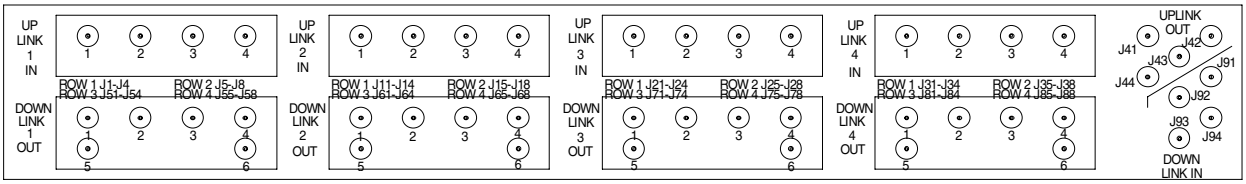

Figure 2-2. Rear Panel Connectors

Table 2-1. Rear Panel Connectors

Name	Ref. Design.	Connector Type	Function
UPLINK 1	J1-J8	BNC	Uplink IF input
UPLINK 2	J11-J18	BNC	Uplink IF input
UPLINK 3	J21-J28	BNC	Uplink IF input
UPLINK 4	J31-J38	BNC	Uplink IF input
DOWNLINK 1	J51-J58	BNC	Downlink IF output
DOWNLINK 2	J61-J68	BNC	Downlink IF output
DOWNLINK 3	J71-J78	BNC	Downlink IF output
DOWNLINK 4	J81-J90	BNC	Downlink IF output
UPLINK OUT	J41-J44	BNC	Uplink IF output
DOWNLINK IN	J91-J94	BNC	Downlink IF input

Table 2-2. Front Panel Connectors

Name	Ref. Design.	Connector Type	Function
UPLINK MON	1-4	BNC	U/L sampled output
DNLINK MON	1-4	BNC	D/L sampled input

The use of each of these connectors is described in the following paragraphs.

2.3.1 Uplink Inputs

These are the four channels of the four or more IF inputs from the modems that are combined to form the transmitted signal paths. The connector type is BNC, and the input impedance is 75Ω (50Ω optional).

2.3.2 Downlink Outputs

These are the four channels of four or more IF outputs that are divided to form the received signal paths to the modems. The connector type is BNC, and the output impedance is 75Ω (50Ω optional).

2.3.3 Uplink Output

These are the four channels of combined IF inputs that are output to the transmitter. The connector type is BNC, and the output impedance is 75Ω (50Ω optional).

2.3.4 Downlink Input

These are the four channels that divide the signals from the receiver. The connector type is BNC, and the input impedance is 75Ω (50Ω optional).

2.3.5 Uplink Monitor

These four outputs provide a means to check the summed IF signals. Each sample is taken by a 20 dB directional coupler. The connector type is BNC, and the output impedance is 75Ω (50Ω optional).

2.3.6 Downlink Monitor

These four outputs provide a means to check the received IF signals. Each sample is taken by a 20 dB directional coupler. The connector type is BNC, and the output impedance is 75Ω (50Ω optional).

Chapter 3
THEORY OF OPERATION

3.1 Operations

The ICS-75 block diagram is shown in Chapter 1.

Since the combiner shelf is composed entirely of passive components, no power inputs are required.

Each of the eight channels enclosed in the combiner shelf is made up of a power combiner/divider and a directional coupler.

The polarity of the directional coupler depend on whether the channel is an uplink or downlink.

The combiner/divider circuits in the combiner shelf are capable of holding four, six, or eight input/output connectors. The exception to this configuration is “Downlink 4 in.”

At “Downlink 4 in,” the chassis can accommodate a larger housing to extend the number of connectors to 10.

Refer to Figure 2-1 for a typical interconnect diagram, and Figure 2-2 for one possible configuration option.

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Chapter 4 MAINTENANCE

4.1 System Faults

Since the ICS-75 is made entirely of passive components, it provides extremely reliable service.

Refer to Chapter 2 for installation instructions.

Note: All unused connectors must be terminated with 75Ω (50Ω for the 50Ω option).

Fault	Possible Problem and Action
Excessive Insertion Loss	Check Table 1-1 in Chapter 1 for allowable insertion loss. Verify all unused connectors have 75Ω terminators. (50Ω for the 50Ω option). Check external cables for broken connections and proper impedance. Verify system configuration for proper input and output connections (Refer to Chapter 2). If all external connections are proper, return the unit for repair.

4.2 Module Replacement

No user-replaceable modules are contained in the ICS-75 combiner shelf.

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Glossary

The following is a list of acronyms and abbreviations that may be found in this manual.

Acronym/ Abbreviation	Definition
Ω	Ohms
16QAM	16 Quadrature Amplitude Modulation
8PSK	8 Phase Shift Keying
A	Ampere
A/D	Analog to Digital
AC	Alternating Current
ADC	Analog to Digital Converter
ADJ	Adjust
ADMA	Amplitude Domain Multiple Access
ADPCM	Adaptive Differential Pulse Code Modulation
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
AIS	Alarm Indication Signal
AM	Amplitude Modulation
AMI	Alternate Mark Inversion
AOC	Automatic Offset Control
APM	Amplitude Phase Modulation
ASC	Add-Select-Compare
ASCII	American Standard Code for Information Interchange
ASK	Amplitude Shift Keying
ASYNC	Asynchronous
AUPC	Automatic Uplink Power Control
AUX 1	Auxiliary 1
AVC	Automatic Volume Control
BB	Baseband
BCD	Binary Coded Decimal
BER	Bit Error Rate
BER CONT	BIT Error Rate Continuous
bit/s	bits per second
BPSK	Bi-Phase Shift Keying
BTU	British Thermal Unit

BW	Backward Alarm or Bandwidth
BWR	Bandwidth Ratio
C	Celsius
C/N	Carrier-to-Noise Ratio
C/No	Carrier-to-Noise Density Ratio
CCITT	International Telephone and Telegraph Consultative Committee
CDMA	Code Division Multiple Access
CH	Channel
CHNL	Channel
CIC	Common Interface Circuit
CL	Carrier Loss
CLK	Clock
CLNA	C-band LNA
CLR	Clear
CMOS	Complementary Metal Oxide Semiconductor
Coax	Coaxial
Codec	Coder/Decoder
COM	Common
CPFSK	Continuous-Phase Frequency Shift Keying
CPSK	Coherent Phase Shift Keying
CPU	Central Processing Unit
cr	Carriage Return
CRC	Cyclic Redundancy Check
CRT	Cathode Ray Tube
CS	Clear to Send
CSC	Comstream Compatible
CSMA	Carrier Sense Multiple Access
CTS	Clear to Send
CU	Channel Unit
CW	Continuous Wave
D&I	Drop and Insert
D/A	Digital-to-Analog
D/C	Down Converter
DAC	Digital-to-Analog Converter
DAMA	Demand Assignment Multiple Access
dB	Decibels
dB/Hz	Decibels/Hertz (unit of carrier-to-noise density ratio)
dBc	Decibels referred to carrier
dBm	Decibels referred to 1.0 milliwatt
dBm0	The signal magnitude in dBm referenced to the nominal level at that point
dBW	Decibels referred to 1.0 watt
DC	Direct Current
DCE	Data Circuit Terminating Equipment
DCPSK	Differentially Coherent Phase Shift Keying
DDO	Drop Data Output
DDS	Direct Digital Synthesis
Demod	Demodulator
DEMUX	Demultiplexer
DET	Detector
DM	Data Mode
DPCM	Differential Pulse Code Modulation
DPSK	Differential Phase Shift Keying
DSP	Digital Signal Processing
DSR	Data Signal Rate
DTE	Data Terminal Equipment
E&M	Ear and Mouth

E_b/N_0	Bit Energy-to-Noise Ratio
ECL	Emitter Coupled Logic
EDP	Electronic Data Processing
EEPROM	Electrically-Erasable Programmable Read-Only Memory
EFD	EFData Compatible
EIA	Electronic Industries Association
EMC	Electro-Magnetic Compatibility
EMF	Electromotive Force
EPROM	Erasable Read-Only Memory
ESC	Engineering Service Circuit or Engineering Service Channel
ESD	Electrostatic Discharge
EXC	External Clock
EXT	External Reference Clock
FDC	Fairchild Data Compatible
FDMA	Frequency Division Multiple Access
FEC	Forward Error Correction
FET	Field Effect Transistor
FFSK	Fast Frequency Shift Keying
FIFO	First in/First Out
Flt	Fault
FM	Frequency Modulation
FPGA	Field Programmable Gate Array
FS	Frame Sync
FSK	Frequency Shift Keying
FW	Firmware
GHz	Gigahertz (10^9 hertz)
GND	Ground
HI STAB	High Stability
HPA	High Power Amplifier
Hz	Hertz (cycle per second)
I&Q	In-Phase and Quadrature
I/O	Input/Output
IBS	INTELSAT Business Services
IC	Integrated Circuit
IDI	Insert Data Input
IDR	Intermediate Data Rate
IESS	INTELSAT Earth Station Standards
IF	Intermediate Frequency
INMARSAT	International Maritime Satellite Organization
INTELSAT	International Telecommunications Satellite Organization
ISD	Insert Send Data
k	kilo (10^3)
KΩ	kilo-ohms
kbit/s	Kilobits per second (10^3 bits per second)
kHz	Kilohertz (10^3 Hertz)
ks/s	Kilosymbols Per Second (10^3 symbols per second)
kW	Kilowatt (10^3 Watts)
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
lf	Line Feed
LNA	Low Noise Amplifier
LO	Local Oscillator
LSB	Least Significant Bit
LSI	Large Scale Integration (semiconductors)
m	mille (10^{-3})
M&C	Monitor and Control

mA	Milliamperes
Max	Maximum
Mbit/s	Megabits per second
MC	Monitor and Control
MFS	Multiframe Sync
MHz	Megahertz (10^6 Hertz)
Min	Minimum or Minute
Mod	Modulator
MOP	Modulated Output Power
MPC	Microprocessor Controller
ms	Millisecond (10^{-3} second)
Ms/s	Megasymbols per second
MSB	Most Significant Bit
MUX	Multiplexer
n	nano (10^{-9})
N/A	Not Applicable
NACK	Negative Acknowledgment
NC	No Connection or Normally Closed
NO	Normally Open
NRZ	Non-Return to Zero (code)
ns	Nanosecond (10^{-9} second)
OQPSK	Offset Quadrature Phase Shift Keying
OSC	Oscillator
p	pico (10^{-12})
P-P	Peak-to-Peak
P/AR	Peak to Average Ratio
PAL	Programmable Array Logic
PC	Printed Circuit
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PECL	Positive Emitter Coupled Logic
pF	PicoFarads (10^{-12} Farads)
PK	Peak
PLL	Phase-Locked Loop
PN	Pseudo-Noise
PPM	Parts Per Million
PS	Power Supply
PSK	Phase Shift Keying
PWB	Printed Wiring Board
PWR	Power
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RAM	Random Access Memory
RD	Receive Data
REF	Reference
RF	Radio Frequency
RLSD	Receive Line Signal Detect
RMA	Return Material Authorization
ROM	Read-Only Memory
RR	Receiver Ready
RS	Ready to Send
RT	Receive Timing
RTS	Request to Send
RX	Receive (Receiver)
RXCLK	Receive Clock
RXD	Receive Data
RZ	Return-to-Zero

s	Second
S/N	Signal-to-Noise Ratio
SCPC	Single Channel Per Carrier
SCR	Serial Clock Receive
SCT	Serial Clock Transmit
SCTE	Serial Clock Transmit External
SD	Send Data
SFS	Subframe Sync
SMS	Satellite Multiservice System
SN	Signal-to-Noise Ratio
SSB	Single-sideband
SSPA	Solid State Power Amplifier
ST	Send Timing
SW	Switch
SYNC	Synchronize
TB	Terminal Block
TCXO	Temperature-Compensated Crystal Oscillator
TDMA	Time Division Multiple Access
TEMP	Temperature
TERR	Terrestrial
TP	Test Point
TT	Terminal Timing
TTL	Transistor-Transistor Logic
TX	Transmit (Transmitter)
TXCLK	Transmit Clock
TXD	Transmit Data
TXO	TX Octet
U/C	Up converter
UART	Universal Asynchronous Receiver/Transmitter
UHF	Ultra-high Frequency
UNK	Unknown
US	United States
UW	Unique Word
V	Volts
VAC	Volts, Alternating Current
VCO	Voltage-Controlled Oscillator
VCXO	Voltage-Controlled Crystal Oscillator
VDC	Volts, Direct Current
VSWR	Voltage Standing Wave Ratio
W	Watt
WG	Waveguide

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METRIC CONVERSIONS

Units of Length

Unit	Centimeter	Inch	Foot	Yard	Mile	Meter	Kilometer	Millimeter
1 centimeter	—	0.3937	0.03281	0.01094	6.214×10^{-6}	0.01	—	—
1 inch	2.540	—	0.08333	0.2778	1.578×10^{-5}	0.254	—	25.4
1 foot	30.480	12.0	—	0.3333	1.893×10^{-4}	0.3048	—	—
1 yard	91.44	36.0	3.0	—	5.679×10^{-4}	0.9144	—	—
1 meter	100.0	39.37	3.281	1.094	6.214×10^{-4}	—	—	—
1 mile	1.609×10^{5}	6.336×10^{4}	5.280×10^{3}	1.760×10^{3}	—	1.609×10^{3}	1.609	—
1 mm	—	0.03937	—	—	—	—	—	—
1 kilometer	—	—	—	—	0.621	—	—	—

Temperature Conversions

Unit	° Fahrenheit	° Centigrade
32° Fahrenheit	—	0 (water freezes)
212° Fahrenheit	—	100 (water boils)
-459.6° Fahrenheit	—	273.1 (absolute 0)

Formulas
C = (F - 32) * 0.555
F = (C * 1.8) + 32

Units of Weight

Unit	Gram	Ounce Avoirdupois	Ounce Troy	Pound Avoir.	Pound Troy	Kilogram
1 gram	—	0.03527	0.03215	0.002205	0.002679	0.001
1 oz. avoir.	28.35	—	0.9115	0.0625	0.07595	0.02835
1 oz. troy	31.10	1.097	—	0.06857	0.08333	0.03110
1 lb. avoir.	453.6	16.0	14.58	—	1.215	0.4536
1 lb. Troy	373.2	13.17	12.0	0.8229	—	0.3732
1 kilogram	1.0×10^{3}	35.27	32.15	2.205	2.679	—

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