

1.0 *KLfiber* system descriptions:

1.1 The *KLfiber* systems offer over 400 configurations, providing users the ability to select their individual operational needs. Primarily, these systems provide the user the option of selecting five primary links: Television Receive Only (TVRO); Very Small Aperture Terminal (VSAT) transmit and receive; Global Position Satellite (GPS) fiber optic link; Search and Rescue (SAR); and a non-powered Multiplexer/Demultiplexer (MUX/DEMUX). Once installed and optimized for individual installations, the *KLfiber* systems require no operator intervention. A typical fiber system set is illustrated in Figures 1 through 4. The *KLfiber* systems are configured as defined by Table 1.

1.1.1 The *KLfiber* KLxT TVRO fiber transmission system consists of: a KLRT Remote Fiber Converter Unit (FCU), installed within the user's antenna; and a KLCT Central FCU, installed either within a central operations facility or a broadcast room. The KLxT system provides: simplex L-band to fiber conversion of four independent TVRO channels provided by the customer equipment; simplex fiber to L-band conversion of those four discrete TVRO channels providing broadcast quality TV to customer equipment; asynchronous duplex interface signaling for Monitor & Control (M&C) of central and remote customer equipment; and the selection of bias-signaling for TVRO broadcast equipment operation.

The KL fiber system configuration has been designed as follows:

Channel 1: Operator Selectable C or Ku Low-band (KuLO) channel – C-band Right Hand Circular Polarized (RHCP) or vertically polarized channel – if linear – **OR** a KuLO vertically polarized channel.

Channel 2 provides a Ku high-band (KuHI) channel – vertically polarized. {Continuously available}

Channel 3 provides a KuHI channel – horizontally polarized. {Continuously available}

Channel 4: Operator Selectable C or KuLO band channel – C-band Left Hand Circular Polarized (LHCP) or horizontally polarized channel – if linear – **OR** a KuLO horizontally polarized channel.

1.1.2 The *KLfiber* KLxV VSAT fiber transmission system consists of: a KLRV Remote FCU, installed within the user's antenna; and a KLCV Central FCU, installed either within a central operations facility or a radio room. The KLxV fiber system provides: two independent transceiver sets, providing two independent transmit/receive transmission channels converting the VSAT receive L-band to fiber and the VSAT transmit fiber to L-band; asynchronous duplex interface signaling for M&C of central and remote customer equipment.

The KL fiber system configuration has been designed as follows:

Channel 1: C-band RHCP Transmit outbound

Channel 2: C-band LHCP Receive inbound

Channel 3: C-band LHCP Transmit outbound

Channel 4: C-band RHCP Receive inbound

1.1.3 The *KLfiber* KLxG GPS fiber transmission system is a new product line and consists of: a KLRW8G Remote FCU, installed on the ship's mast; and a KLCW8G Central FCU, installed within the central operations spaces. The KLxW8G fiber system provides: a single fiber transmitter converting the L1/L2 GPS L-band signals to fiber; a single asynchronous duplex M&C fiber converter providing command and control (C&C) of the GAS-1 antenna equipment (AE); a single asynchronous duplex M&C fiber converter providing command and control M&C of the fiber transmitter; and direct current voltage for the AE antenna's LNA.

The KLxW8G implements 8:1 MUX/DEMUX functionality resulting in fewer core fibers required between the remote and central unit.

Due to the isolation of the remote unit, an M&C scheme has been developed to totally eliminate the necessity for a technician's operation of this unit. All of the fiber system M&C functions are present within the ship's operating space.

1.1.4 The *KLfiber* KLxS SAR fiber transmission system consists of: a KLRS Remote FCU, installed within the user's antenna; and a KLCS Central FCU, installed within a central operations facility. The KLxS fiber system provides: a single fiber transmitter converting the primary L-band SAR signals to fiber; and a single

asynchronous duplex M&C fiber converter providing command and control M&C of central and remote customer equipment.

The KL fiber system configuration has been designed as follows:

Channel 1: L-band or S-Band LHCP or RHCP receive inbound

Channel 2: System M&C

- 1.1.5 The **KLfiber** KLMx MUX/DEMUX fiber transmission system consists of a non-powered unit which is required to: reduce the complexity of certain system designs, thereby reducing the cost of long-line transmission fiber trunk cabling; or to optimize the design of certain system configurations.

2.0 System Design Criteria

The **KLfiber** system designs have evolved and resulted from years of user experiences. They incorporate cost effectiveness in system configurations. They provide either: military qualified or commercial equivalence of components; military qualified or commercial equivalence of physical interfaces. They incorporate flexibility in M&C configurations. Serial RS-232 or RS-422 is the standard M&C implemented. Standard Ethernet, Ethernet over Copper (EoC) or wireless M&C channels are also available upon request.

The fiber link criteria is always critical and as such, **KLfiber** system designs incorporate the fiber link margins required in setting up pre-installed systems. As an example, a 1600 foot trunk between the remote and central unit results in an approximate insertion loss of 6.00dB. **KLfiber** L-band system assemblies provide a nominal dynamic range of approximately 12.1dB providing a link margin of approximately 6.10dB. **KLfiber** M&C assemblies provide a nominal dynamic range of approximately 16.00dB providing a link margin of 9.80dB. Factory pre-sets are incorporated into the fiber converter assemblies (FCA) to optimize the operability of the fiber link to support the link margins.

Electromagnetic and Radio Frequency compatibility are corner stones of all **KLfiber** system designs. Lightning surge protection is also provided on all coaxial L-band channels and, when implemented, EoC channels.

Mean Time Between Failure (MTBF) of parts and components integrated into the **KLfiber** systems are a key factor of their design. Currently, the **KLfiber** systems have a calculated MTBF of >51,000 hours (5.82Years).

3.0 System Implementation

- 3.1 TVRO: The implementation of KLxT systems requires that the user definitions of the broadcast system provide: the TVRO broadcast channel definitions, i.e., C-Band, KuLO, KuHI bands, linear, or circular; the required number of broadcast channels; and space available within the user's antenna and within the broadcast space.

The **KLfiber** TVRO KLCT Central Units provide the user the ability to provide their broadcast equipment the necessary Integrated Receiver-Decoder (IRD) bias voltage of +13VDC/+18VDC or none if not required.

The KLRT Remote Units have been designed and configured to provide the antenna Low Noise Block-converter (LNB) the necessary bias voltage to coincide with the required broadcast channel polarization.

- 3.2 VSAT: The implementation of KLxV systems requires that the user definitions of the broadcast system provide: the VSAT broadcast channel definitions, the M&C necessary for operations; and space available within the user's antenna and within the broadcast space.
- 3.3 GPS: Implementation of the KLxG systems require very little user definitions as the interfaces are limited to: the conversion of GPS L1/L2 L-band from the AE to the GPS receiver; the C&C interface between the GPS receiver to and from the AE; and the fiber FCA M&C between the KLW8RG and the KLCW8G.
- 3.4 SAR: Implementation of the KLxS systems also requires very little user definitions as the interfaces are limited to: the conversion of L-band or S-Band L-band (nominally 1544.4MHz and 2226MHz from the antenna group to the SAR receiver baseband equipment; and the fiber FCA Serial M&C between the KLCS Central Unit and the KLCS Remote Unit.
- 3.5 MUX/DEMUX: Implementation of MUX/DEMUX is dependent solely upon user fiber trunk utilization. These units have been designed to support 4:1, 8:1 and 16:1 functionality. They are totally non-powered units

which were designed to provide multiplexing of multiple fiber nodes onto a single fiber trunk, thereby reducing costly multi-core cable requirements to a minimum.

The functionality of the MUX/DEMUX has been implemented with a simple Coarse Wave Division Multiplex (CWDM) scheme. This functionality has also been integrated into many of the **KLfiber** fiber transmission systems whenever minimizing the trunks are required or desired.

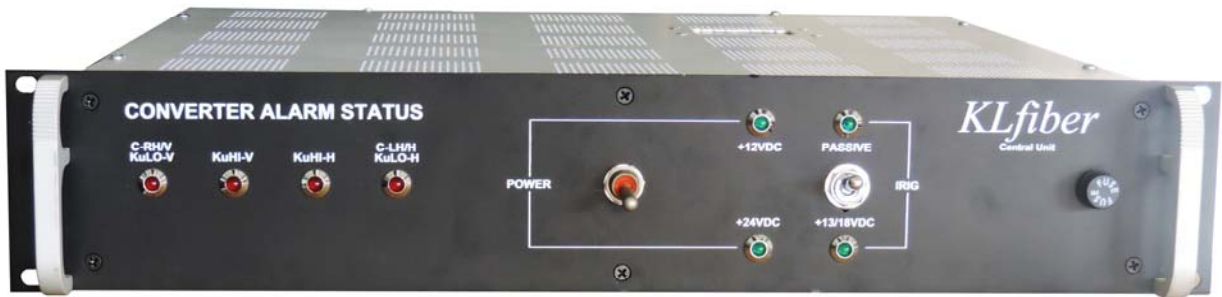


Figure 1. KLCT4-526MM-S4B: TVRO Four-Channel Central Fiber Unit – Front View



Figure 2. KLCT4-526MM-S4B: TVRO Four-Channel Central Fiber Unit – Rear View

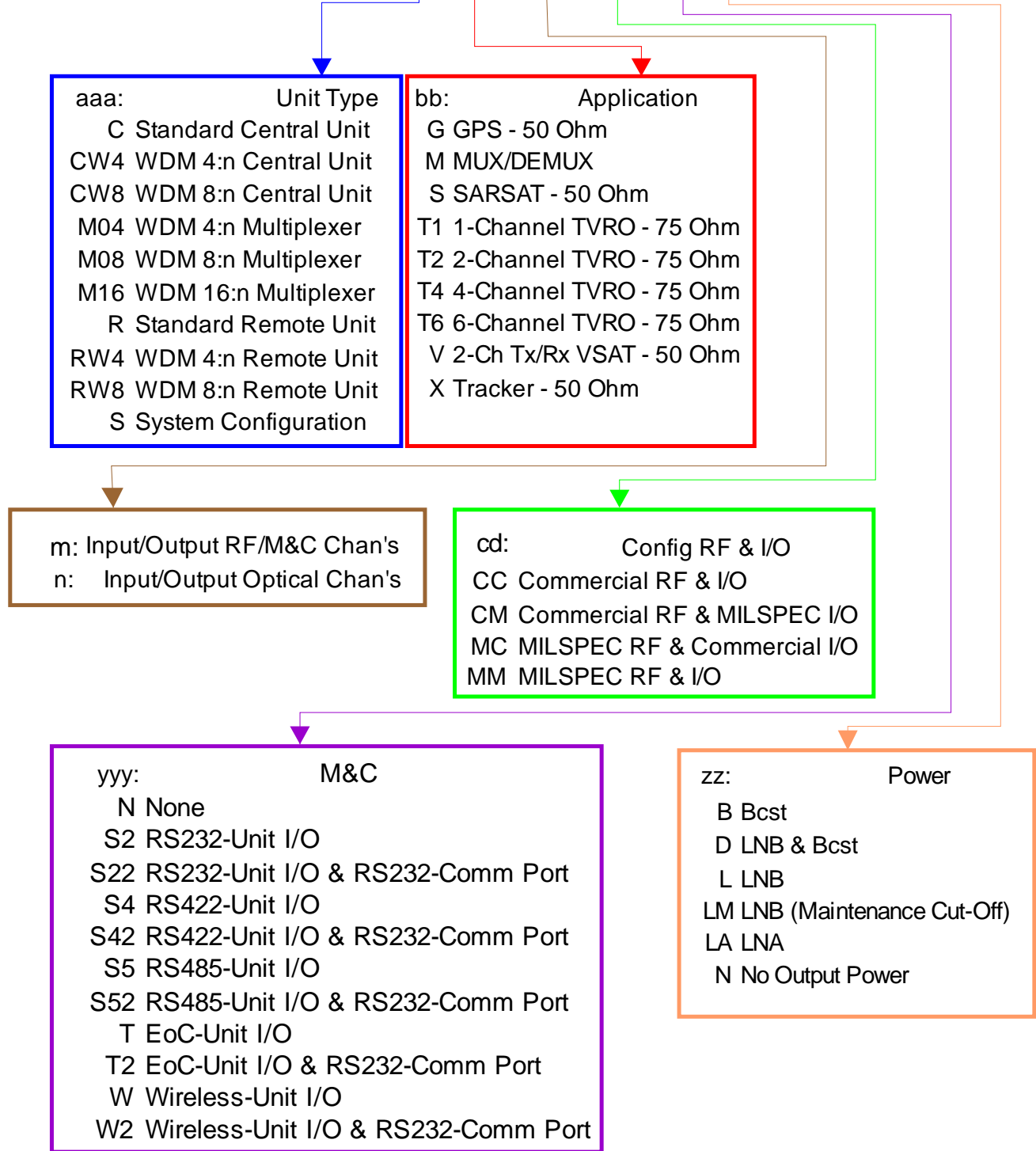


Figure 3. KLRT4-426MM-S4L: TVRO Four-Channel Remote Fiber Unit – Top View



Figure 4. KLRT4-426MM-S4L: TVRO Four-Channel Remote Fiber Unit – Front View

KLaabb-m2ncd-yyyzz



Examples:

- KLCT4-526MM-S2B:** TVRO 4-Chan Central Unit; Military RF & I/O Connectivity; Serial RS232 remote device M&C; Switchable Passive or Active +13/+18VDC IRD power.
- KLRV-526MC-TN:** VSAT Duplex Tx/Rx 2-Chan Remote Unit; Military RF & Commercial I/O Connectivity; Ethernet over Copper remote device M&C; Remote device power not provided.
- KLRW8T4-621MM-S42L:** TVRO 4-Chan with 8:1 WDM Remote Unit; Military RF & I/O Connectivity; Serial RS422 remote device M&C and RS232 Local Comm port; LNB power.

Table 1. *KLfiber System* Configuration Chart