

3K SERIES HDTV FIBRE OPTIC INTERCONNECTION SYSTEMS (CONNECTORS, CABLES AND ACCESSORIES)



Evolution of HDTV interconnection systems.

In 1994 the Japanese ARIB committee commenced extensive testing over a 2 year period to determine the best options for cables and connectors standards in anticipation of the country's switch to HDTV broadcasting. Four connector and three cable manufacturers products were thoroughly tested to evaluate the best connector and cable combination for system requirements and outside broadcast environments, and in 1997 the ARIB Standard BTA S-1005B was issued, covering both connectors and cables.

Requirements of the connector standard included plug and socket style to permit daisy chaining without using adaptors. Multichannel hybrid configuration (2 single mode fibres) was sought with low Insertion Loss (<0.5dB) and good Return Loss (>45dB) results on a repeatable basis in order to minimise system optical power budget and protect optical devices. Clearly the system needed to be ruggedised for use in outdoor harsh environment with sealing against moisture and dust (to IP68) and a push-pull system with multiple keys was preferred for quick connection and easy blind mating. Additional requirements were excellent EMC properties, smaller size than common triax to more closely match the size of the new hybrid cables and a very strong connection between cable and connector that would be able to survive the abuse to which cables can be subjected in the application. An example of the demanding tests was the 500 mating cycle dust test, which only one connector passed. The connector design that met all the requirements is the LEMO 3K.93C range.

In 1998 SMPTE issued Standard 304M, which was similar to the ARIB standard, and ANSI ratified the Standard and gave it the same number. At the same time SMPTE also issued Standard 311M to cover a hybrid fibre optic cable. Standards 304M and 311M are linked by cross reference and referral.

In 1999 the EBU issued Standard R100-1999 for connectors making reference to both the ARIB and SMPTE standards to the effect that the EBU standard has broadly the same requirements.

LEMO connector system fully proven in demanding environments.

With over 20,000 of these connectors in use the LEMO 3K.93C connector system has proven itself in many different applications from studio and stadium installations to regular OB van use. The system has increasingly been used at all major Olympic events starting with Atlanta in 1996 and the Nagano winter Olympics in 1998, right through to the recent winter Olympics in Turin.

In 1996 one of the earliest installations was at The Portland Trailblazers Arena, and other installations since include Madison Square Gardens, the Royal Opera House and most of the football arenas in Germany for the 2006 World cup.

Manufactured in stainless steel, the 3K.93C connector incorporates the highly reliable LEMO push-pull latching system and is suitable for up to 20,000 mating cycles and above. With proper termination the fibre contact is also suitable for this level of endurance.

The use of fibre optics means that transmission can be made over much longer distances using digital signals from the camera to the base station and at a much higher level of definition.

However, the performance of the interconnection is critical if this benefit is to be fully exploited. Features and benefits of the LEMO system are as follows:

- **Push-Pull self-latching system for quick & easy mating**
- **Compact design with: 2 fibres, 2 power contacts and 2 signal contacts**
- **Very low optical losses (< 0.30 dB) with constant repeatability at every connection**
- **Easy cleaning of fibre optic contacts**
- **Sealed for environmental protection (IP 68) to give reliable outdoor use**
- **Unique 5 keys (code W) system allowing smooth and blind mating**
- **UL 498 recognition**
- **Use of plug and socket connectors for easy chaining of cables**
- **Pre-terminated cables available**
- **World-wide product support**

The LEMO HDTV Camera connectors use the F2 type Fibre Optic contact. This contact employs ceramic technology in order to achieve optical performance of the highest standard. Simple and fast polishing ensures physical contact of the fibre endfaces, and the same basic contact is used in all of the connector models. An alignment device is simply clipped onto the front of the Fibre Optic contact to convert it to female version and this alignment device can be easily removed in order to clean the fibre endface.

High performance connectors need high performance cables and quality termination.

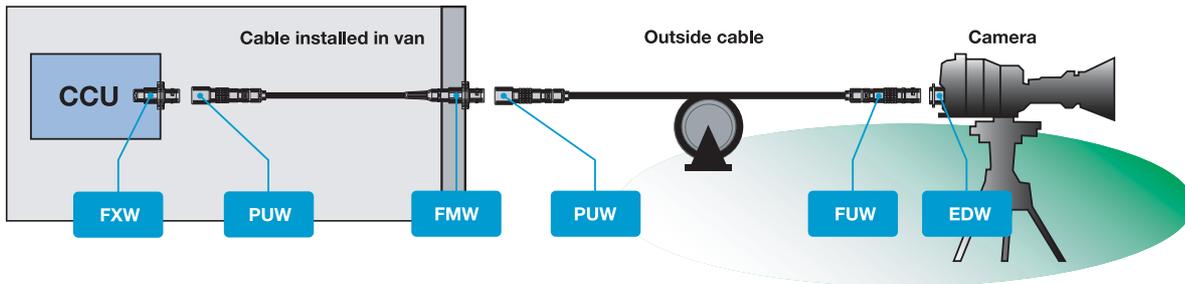
LEMO UK are offering cable supplied by Furukawa Electric - the market leader in Japan for hybrid camera cables for HD applications. These cables incorporate two singlemode fibres, two power conductors and two low voltage conductors in a very high quality construction, reinforced by a stainless steel strength member – see page 5.

A quality termination service is offered by LEMO to ensure that the resulting cable assembly is to the highest standard and suitable for use for the demanding environments experienced within the Broadcast market. As well as standard plug-socket assemblies, special requirements can be easily accommodated. Both optical and electrical tests are carried out on each and every cable assembly prior to despatch.

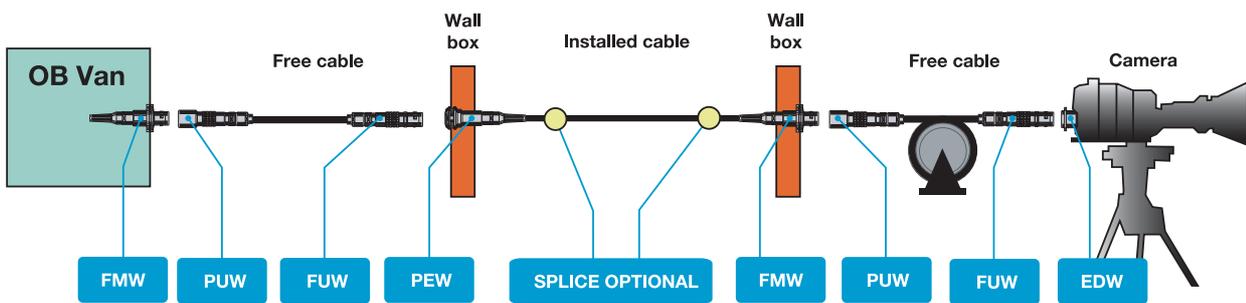
Typical layouts.

Below are shown typical layouts for HTDV systems with recommended connector models – for example *FUW.3K93C.TLMC96* is shown as 'FUW'. For further details of connectors please see page 4.

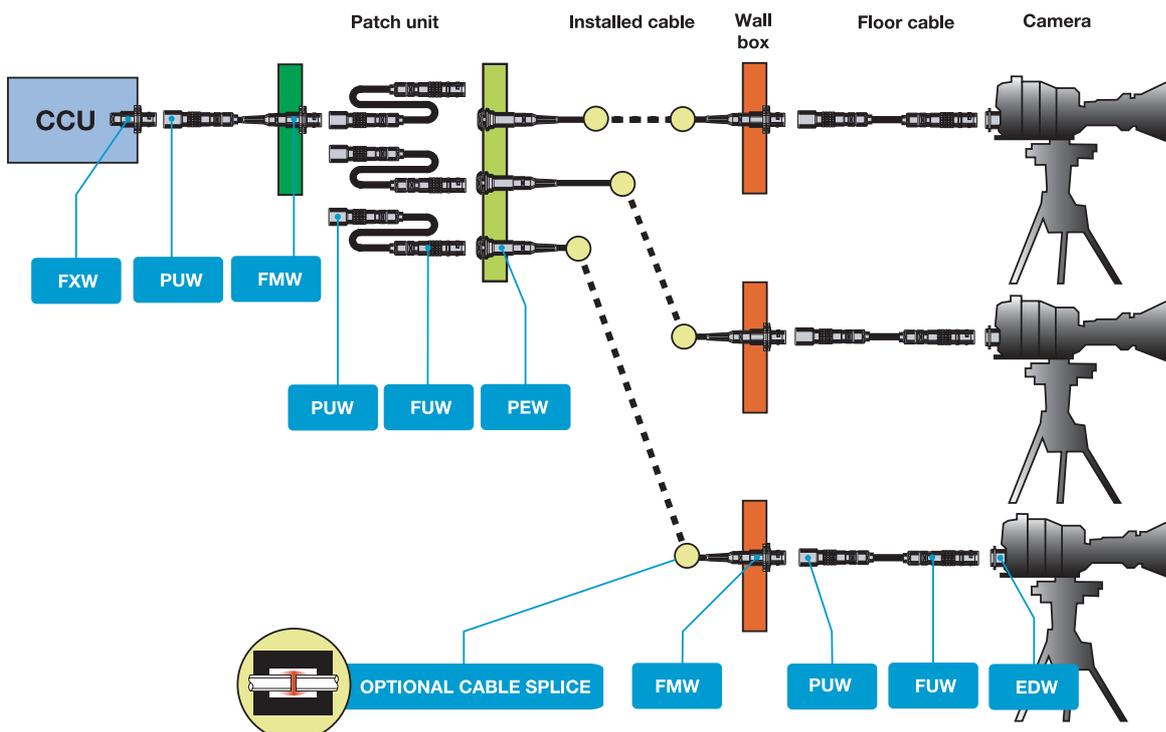
OUTSIDE BROADCAST VAN



STADIUM



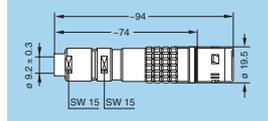
STUDIO



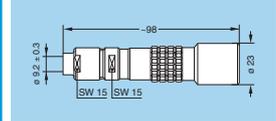
Connectors and components

Below are shown the most popular connector and accessory options. Other options are available - please see the LEMO fibre optic connector catalogue

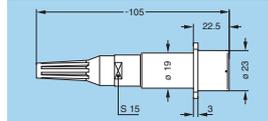
FUW.3K.93C.TLMC96



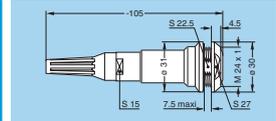
PUW.3K.93C.TLCC96



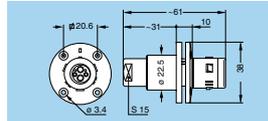
FMW.3K.93C.TLMT96Z



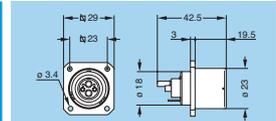
PEW.3K.93C.TLCT96Z



FXW.3K.93C.TLM



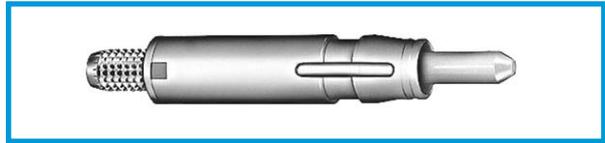
EDW.3K.93C.TLC



FIBRE OPTIC CONTACTS – ORDERED SEPARATELY

Male contact	FFS.F2.BA2.LCE30
Female contact*	PSS.F2.BA2.LCE30
Alignment device	PSS.F2.290.NZZ

*Female contact is male + alignment device



PROTECTIVE BOOTS FOR FUW/PUW.

Boot for FUW	GMF.3K.085.EANZ
Boot for PUW	GMP.3K.085.EANZ
Coloured ring for boots	See table opposite



Part Number	Colour
GMF.3K.265.RG	grey
GMF.3K.265.RN	black
GMF.3K.265.RR	red
GMF.3K.265.RV	green

STRAIN RELIEF SLEEVES FOR FMW, PEW

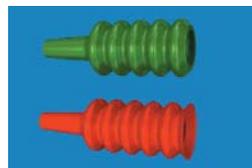
Part number for black sleeve to suit standard ARIB and SMPTE cable 9.2mm diameter: GMA.3B.090.DN
Other diameters available on request.
Change last letter of part number "N" for different colour as per table.



Part Number	Colour
A	blue
B	white
G	grey
J	yellow
M	brown
N	black
R	red
S	orange
V	green

GAITERS FOR ADDITIONAL PROTECTION FOR OUTDOOR APPLICATIONS

Protective gaiter



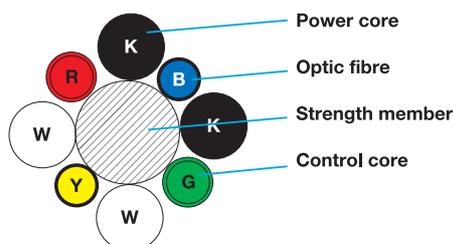
Part Number	
UKP.07.0487.05	Male, Green - suggested for use with FUW plugs
UKP.07.0487.04	Female, Red - suggested for use with PUW sockets
UKP.07.0487.01	Male, Black
UKP.07.0487.02	Female, Black

Cables – ARIB, SMPTE & EBU hybrid camera cables.

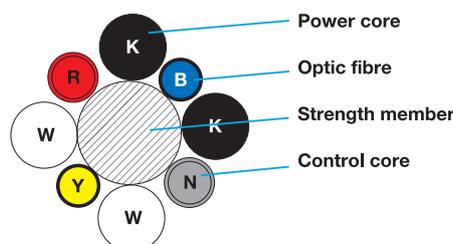
Hybrid camera cables have been specially designed for HDTV Broadcast requirements resulting in the primary standards in Japan and USA. These standards are broadly similar, the main differences being in the colour coding of the control cores (not

possible to use green colour in US for anything other than ground). Whilst the diameter of the central strength member is the same in both standards (1.6mm) some manufacturers use 1.8mm for extra strength.

ARIB standard cable



SMPTE standard cable

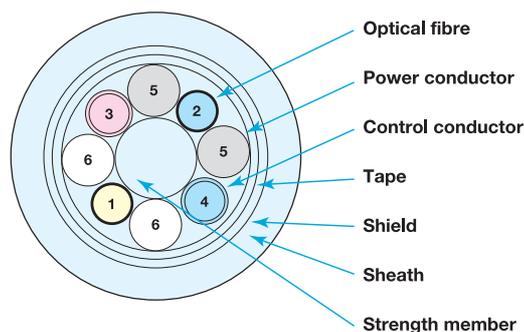


Furukawa 2SM-9.2-37.5 rugged HDTV camera cable

Whilst there are a number of cables available on the market, one cable that has proven extremely successful in the Japanese market is the Furukawa 2SM-9.2-37.5.

Cables in broadcast need to be able to withstand considerable flexing and twisting, which is a challenge for fragile fibre optic cables. In response to such a requirement, Furukawa developed, after extensive research and testing, an HDTV camera cable featuring:

- Rugged, high durability construction
- Ultra-high abrasion resistance
- Excellent flexing and twist capabilities
- Superior load bearing and tensile strength capability



Core number	Type	Colour
1	Optical fibre	Yellow (Head to CCU)
2	Optical fibre	Blue (CCU to Head)
3	Control conductor	Red (hot)
4	Control conductor	Green (cold)
5	Power conductor	Black (hot)
6	Power conductor	White (cold)

Power conductors	Typical data
Conductor resistance	37.5Ohm/km
Insulation resistance	10,000 MOhm/km
Withstand voltage	AC. 1kV/1 min

Composite cable construction

Optical fibre	Special nylon coated singlemode fibre
Power conductor	Tinned annealed copper 21 x 0.8mm ²
Power insulation	0.4mm approx
Control conductor	Tinned annealed copper, 7 x 0.18mm ²
Control insulation	0.3mm approx
Strength member	Insulated stranded stainless steel 1.8mm
Sheath	Special anti abrasion/tear resistant PVC blend
Diameter	9.2 +/- 0.3mm

Optical fibre	Typical data
Attenuation (1300nm)	0.5dB/km
Core	9.5+/- 1µm
Cladding	125+/- 3µm
Outer	0.9 +/- 0.1mm

Control conductors	Typical data
Conductor resistance	113Ohm/km
Insulation resistance	10,000 MOhm/km
Withstand voltage	AC. 1kV/1 min

Mechanical properties of cable

Tensile strength	70kgf
Compression loading resistance	Less than 0.5dB for 1000kgf
Cyclic flexing	Better than 10,000 cycles
Bend radius	Minimum bend radius 6 x dia
Abrasion tolerance	Excellent
Impact test to JIS C3005	No change 7kg at 180mm
Weight	105kg/km approx

Part Number	UKT.0000543
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Accessories/Installation

Protective caps:

Part Number	For connector model
BHA.3K.100.EAN	FMW, FXW
BRA.3K.200.EAN	EDW, PEW
BRF.3K.200.EAN	PUW inside at CCU

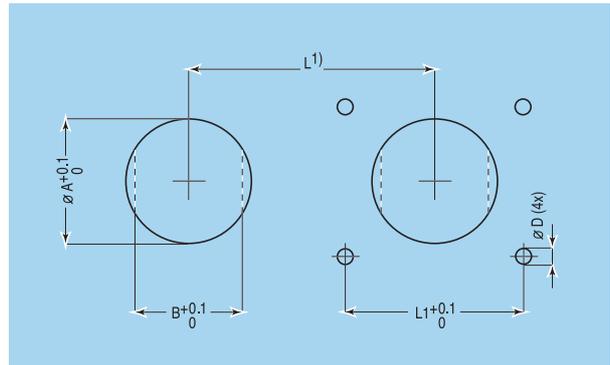
Other caps styles available - see fibre optic catalogue



Panel cut-outs

Models	Dimension (mm)				
	A	B	D	L	L1
FMW, FXW	23.2	-	3.2 or M3	39	20.6
EBW	23.2	-	3.2 or M3	30	23.0
EDW	23.2	-	3.2 or M3	30	23.0
ENW, PEW	24.2	22.6	-	32	-
PBW	23.2	-	3.2 or M3	30	23.0

Note: 1) Minimum distance between two neighbouring components



Cable puller

Whilst it is feasible to terminate and polish LEMO F2 contacts on site, terminations within a controlled factory environment are preferable in order to ensure maximum life for the assembly. This is particularly important for installed cables.

Where there are concerns about the size of the connector on pull-through, one option is the use of the LEMO cable puller, which temporarily replaces the outer shell of the connector. With an outside diameter of only 17.5mm this pull-through tool ensures that the pulling force is applied directly to the central stainless steel strength member of the cable, thus protecting the fragile optical fibres.

Part number: DCS.3K.175.72LN



Panels

A range of patch panels is available to suit most applications usually in 3U size. When enquiring please advise required number of holes, connector that is being mounted and whether angled or straight panel is needed, as well as any other special requirements.



Splice box and fibre splicer

Where it is impossible to pull through terminated cables or where replacement of connectors is anticipated due to location at a vulnerable point an option is fibre splicing. Fibre splice boxes are available on request



Maintenance

It is essential for the ferrule end faces of Fibre Optic contacts to be clean and free from contamination so as to ensure the optimum performance. If system problems are encountered when a connection is made, then all fibre optic contact end faces should be fully cleaned.

A viewer enables quick checking of the status of fibre contacts, and various cleaning methods are available, though the simplest and most reliable option is the use of cotton buds and alcohol – the alignment extraction device is required for cleaning of LEMO female fibre contacts.

Fibre-optic video inspector

A portable fibre optic viewer consisting of handset probe, LCD display, ferrule tips for LEMO and other contacts, USB capture device & software & AC power supply all in a rugged case.

USB version, and Handset version (for external monitor) also available.



Part Number	
UKT.0000659	Complete video inspector kit
UKT.0000665	Handset probe only
UKT.0000671	Handset probe with USB link & software
UKT.0000669	Adaptor for Lemo F2 female contact

Fibre optic ferrule cleaner

1. A motorised ferrule cleaner with replaceable cartridge for fast cleaning in the field. It is recommended that this method does not replace scheduled maintenance cleaning (cotton buds and alcohol).



Before



After

Part Number	
UKT.0000655	Cleaner unit main body
UKT.0000658	Adaptor for Lemo F2 male contact
UKT.0000660	Cleaner cartridge

2. A pocket size disposable ferrule cleaner suitable for up to 500 cleaning cycles
DCT.F2.125.PA



Alignment device extraction tool

Double ended tool for removal of alignment sleeves.
(DCS.F2.033.PN).



F2 contact cleaning tool

Part Number
DCS.91.F23LA



Cotton bud packs

Fibre optic cleaning kit (WST.K1.125.34)

Comprises of 2 cotton buds, 1 dry and 1 being soaked in IPA (Isopropyl Alcohol) Used for cleaning the fibre optic contacts.



Cable assemblies.

Whilst cable assemblies can be tailored to suit individual requirements, the following are ready structured in LEMO UK system and in some cases can be available ex-stock.

All cables consist of stainless steel LEMO connectors mounted to Furukawa cable as indicated.

Part Number	Description
Free standing cables for outside use	LEMO inline plug (FUW model) and inline socket (PUW model) terminated to Furukawa cable in length as shown complete with GMF/GMP strain relief sleeves, with caps, and protective gaiters
UKF.3K.B20.002500	25 metre length
UKF.3K.B20.005000	50 metre length
UKF.3K.B20.010000	100 metre length
UKF.3K.B20.020000	200 metre length
UKF.3K.B20.030000	300 metre length
UKF.3K.B20.050000	500 metre length

Cables for OB van installation	Description
Free standing cables for outside use	LEMO panel mounted plug (FMW model) and inline socket (PUW model) terminated to Furukawa cable in length as shown complete with BHA/BRF caps
UKF.3K.B21.000300	3 metre length
UKF.3K.B21.000500	5 metre length
UKF.3K.B21.001000	10 metre length
UKF.3K.B21.001500	15 metre length
UKF.3K.B21.002000	20 metre length

Other lengths available on request.

Cable drums

Cables are supplied on wooden drums (except short lengths which are coiled) unless otherwise requested.

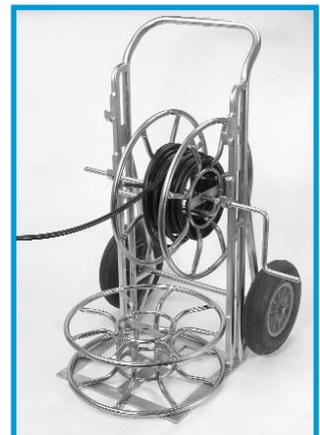


Reels are available on request:

Skeleton drum



Drum stand



LEMO UK

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