

Advanced Technology

TACHII Cable Technology

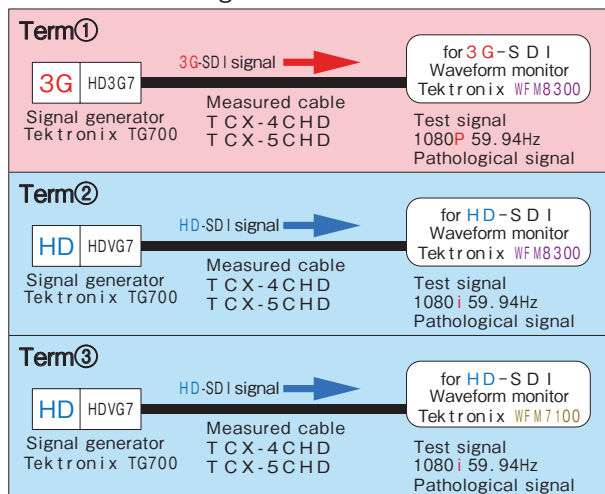
3G-SDI / HD-SDI Transmission

In 2006, 3G-SDI specification was set by SMPTE 424M specification. Single coaxial cable can transmit 2 times volume of existing HD-SDI signal. Our TCX-HD series has been developed subject to transmit 3G-SDI from the beginning, therefore, customers can comfortably use with satisfaction like the existing HD-SDI transmission.

Each SDI transmission distance is set in accordance with SMPTE specification. The standard distance is calculated based on the actual measurement of our coaxial cable, referring to SMPTE specification. (The figure is typical value, not guaranteed.)

However, it is becoming clear that the transmission distance is rather longer than the standard at the right table against the specified figures. TACHII measured on the **max. distance** for 2-types signal of 3G-SDI and HD-SDI as the representative in the combination as undermentioned.

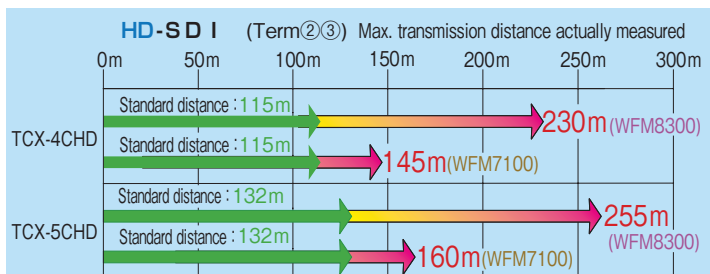
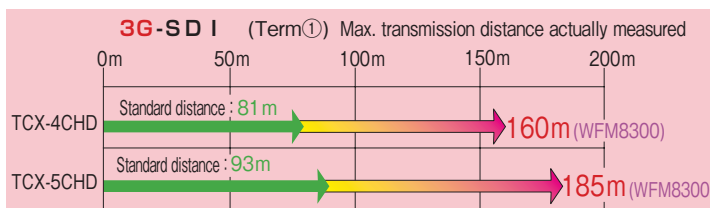
Measuring terms for max. distance



Please take that the above are our measurement actuals, just as reference only. Because the distance may be different, depending on the used environment (materials, temperatures etc.). Two types cable were selected for measurement, prepared by 5m-lot measurable. Judging from the results listed at the right, transmission could be surprisingly confirmed nearly double distance of SMPTE standard when WFM8300 was used (40dB in attenuation). The results were largely different between new and old type of waveform monitor, despite of the same signal in Term 2③. This means it is very important to know in advance max. transmission distance of the used equipment, when the system is actually designed.

Conversion table of standard transmission distance by SDI signal-wise in SMPTE specifications

	3G-SDI SMPTE 424M (2.97Gbps)	HD-SDI SMPTE 292M (1.485Gbps)	SD-SDI SMPTE 259M (270Mbps)
Attenuation	Max.20dB (@1.485GHz)	Max.20dB (@742.5MHz)	Max.30dB (@135MHz)
TCX-2.8CHD	48m	69m	246m
TCX-3CHD	62m	89m	317m
TCX-4CHD	81m	115m	413m
TCX-5CHD	93m	132m	452m
TCX-6CHD	113m	162m	586m
TCX-7CHD	133m	191m	692m
TCX-8CHD	148m	212m	772m
TCX-3CFB	50m	73m	266m
TCX-4CFB	65m	93m	337m
TCX-5CFBL	78m	113m	417m
TCX-7CFBL	108m	158m	596m



※ Max. transmission distance was actually determined, after measuring the distance (of no bit error happened) on the continuous transmission for more than 5 hours.

TCX-3CHD SDI Transmission distance improvement TCX-2.8CHD Wiring on rack for space-saving · lightening

TCX-3CHD, TCX-2.8CHD vs. conventional 3CFB Comparison

	TCX-2.8CHD		3CFB Commodity cable actually measured		TCX-3CHD
Cable O.D.	4.4mm	← abt.20% Thinner	5.5mm	Equivalent level	5.5mm
Cable Weight (100m)	2.6kg	← abt.38% Lighter	4.2kg	abt.9% Lighter	3.8kg
HD-SDI Standard transmission distance	69m	Equivalent level	70m	abt.27% Up	89m
3G-SDI Standard transmission distance	48m	Equivalent level	48m	abt.29% Up	62m

Note : The figures are typical, are not the guaranteed value.

Since our introduction, TCX-2.8CHD has been widely employed in the fields undermentioned, because of contribution to density growth and lightening of broadcasting equipments.

- Space-saving in density router using DIN connector
- Space-saving in wiring on rack
- Space-saving & lightening in big o.b.vans for HD
- Lightening of mobile helicopter, etc.

The requirement has been increased more in the transmission capability of coaxial cable, in accordance with 3G-SDI appearance & 3D image adoption, more densified content signal transmission than before in one cable. TCX-3CHD introduction is one of TACHII's contributions for 3G transmission, in which we have succeeded to improve the transmission distance nearly 30% despite of similar size with 3CFB.

TCX-5CHD SDI Transmission distance improvement **TCX-4CHD** Space-saving · Lightening in room-to-room

Comparison TCX-4CHD, TCX-5CHD vs. 5CFB

	TCX-4CHD	5CFB Commodity measured value	Equivalent level	TCX-5CHD
Cable O.D.	6.5mm <i>abt.15% Thinner</i>	7.7mm		7.7mm
Cable weight (100m)	5.1kg <i>abt.32% Lighter</i>	7.5kg	<i>abt.5% Lighter</i>	7.1kg
HD-SDI Standard transmission distance	115m <i>abt.6% Up</i>	108m	<i>abt.22% Up</i>	132m
3G-SDI Standard transmission distance	81m <i>abt.10% Up</i>	73m	<i>abt.27% Up</i>	93m

Note : The figures are typical, are not the guaranteed value.

5CFB is the most frequently used cable between room-to-room in the connection for broadcasting equipments. TACHII has improved 5CFB in view of ① Thinning · Lightening, ② Transmission distance improvement.

In HD-SDI transmission, customers can enjoy some room in transmission as nearly 30% space-saving in volume ratio and 32% lightening in weight ratio when employing TCX-4CHD which has transmission distance equivalent to 5CFB or more. In 3G-SDI transmission, by any means, the distance becomes shorter than HD-SDI transmission. TCX-5CHD is the most suitable for 3G-SDI transmission, even though nearly same size with 5CFB, and 27% longer than 5CFB. TCX-3CHD, TCX-4CHD and TCX-5CHD are the leading players in over next 3G-SDI era.

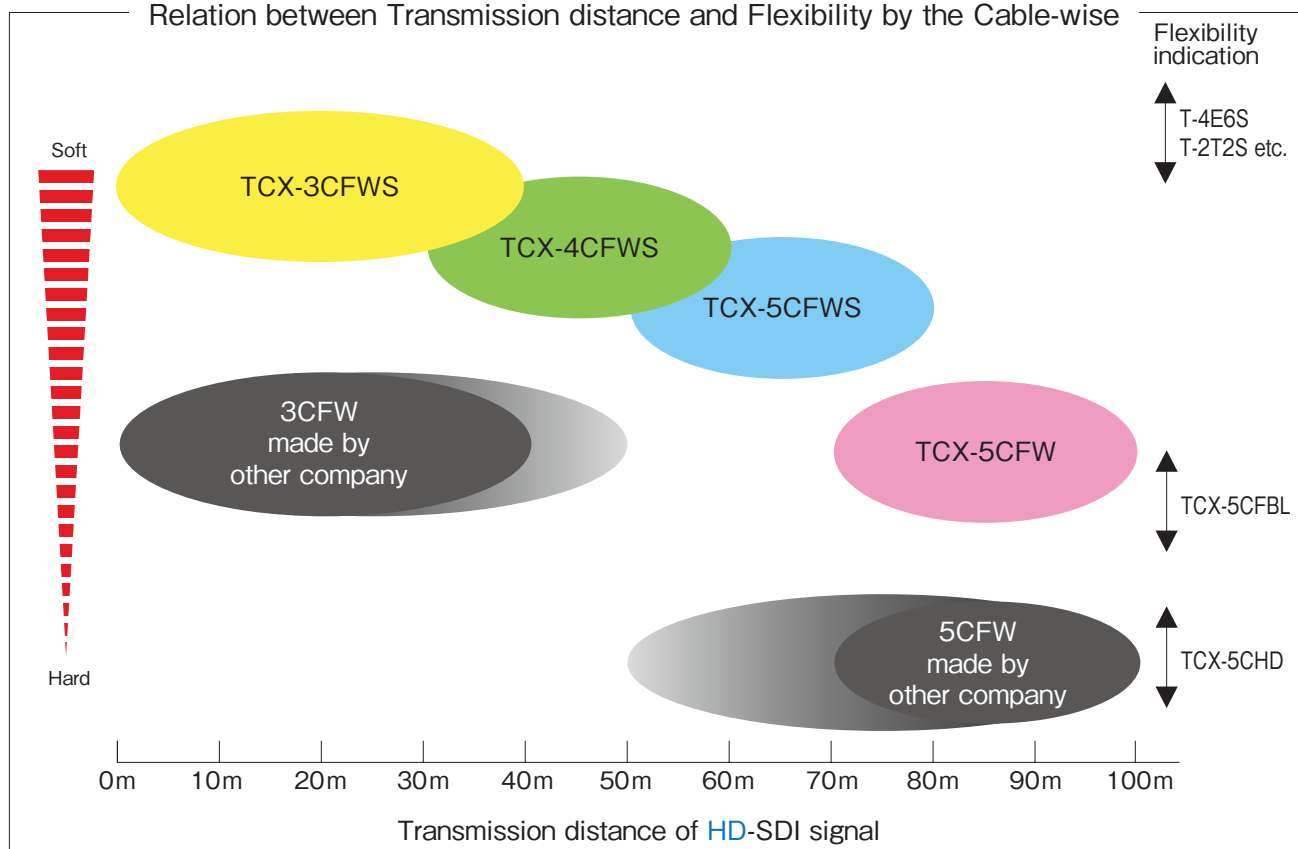
Coaxial cable for mobile application (3G/HD-SDI transmission)

TACHII feels the strongest need for HD-SDI in mobile application used at hookup and in studio etc. therefore, TACHII has added, TCX-4CFWS as the medium size between TCX-3CFWS to TCX-5CFWS in our lineup. These can be used because of better flexibility and better balance in transmission distance / cable size, in the case that 3C not enough but 5C too fat / heavy. TCX-5CFW is also available, higher bendability has been developed even in single conductor specification for 100m length HD-SDI transmission which has not been able to reach so far by TCX-5CFWS. TACHII has employed original designing to cope with the lower temperature situations in winter, extremely hardening-resistant prepared 4 types as our lineup, customers can select the most suitable for respective applications. The undermentioned indicate the relation between HD-SDI transmission distance and bendability to help when cable selections. All those products are also perfectly corresponding to 3G-SDI.

Conversion table for standard transmission distance by SDI signal-wise in SMPTE specifications

	3G-SDI SMPTE 424M (2.97Gbps)	HD-SDI SMPTE 292M (1.485Gbps)	SD-SDI SMPTE 259M (270Mbps)
Attenuation	Max.20dB (@1.485GHz)	Max.20dB (@742.5MHz)	Max.30dB (@135MHz)
TCX-3CFWS	41m	59m	216m
TCX-4CFWS	51m	75m	275m
TCX-5CFWS	60m	87m	324m
TCX-5CFW	70m	104m	383m

Relation between Transmission distance and Flexibility by the Cable-wise



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Digital Microwave link Transmission Cable for mobile application

The 5D-2W max. transmission distance has seriously dropped to 300m in microwave link operation by current digital method unlike in the case of existing analog system. Due to the lack of specification on transmission distance like for HD-SDI signal, maximum transmission distance shows big difference even with same cable by microwave link system maker-wise, and in some cases the transmission distance shows somewhat difference even by same model because of the product variation. 5D-2W has shown the said limitations in the microwave link operation with digital method same as the conventional analog system. Judging from the limitations of 5D-2W coaxial cable in the microwave link operation at hookup points like golf, marathon, soccer etc. where 5D-2W is used to communicate between control unit and head unit, TACHII has newly developed **TCX-5DFW,TCX-5DFWS** coaxial cable for mobile application to materialize long distance transmission in digital microwave link market, utilizing our accumulated know-how in designing and manufacturing to become 5D-2W in next generation. TACHII has materialized by **TCX-5DFW** the maximum long distance transmission with 5D size, keeping equivalent size of 5D-2W. **TCX-5DFWS** has materialized easy workability of figure eight shape winding by soft-finished as well as transmission distance further increase. Both of **TCX-5DFW,TCX-5DFWS** have combined great appeal and influences never find with conventional 5D-2W.

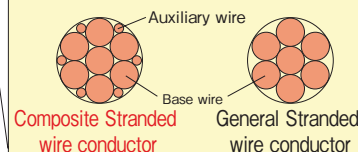
Comparison between TCX-5DFW,TCX-5DFWS vs. 5D-2W

	TCX-5DFW	Equivalent level	5D-2W Commodity actually measured	Equivalent level	TCX-5DFWS
Cable Standard O.D.	8.2mm		8.0mm		8.2mm
Cable Standard weight (100m)	11.9kg		11.1kg		11.5kg
Standard attenuation with 130MHz (per 100m)	8.1dB	← abt.16% Up	9.7dB	→ abt.6% Up	9.1dB
Standard loop resistance	10.2Ω/km	← abt.32% Up	15.1Ω/km	→ abt.23% Up	11.5Ω/km
Cable bendability	△	← Hard to handle	○	→ Improved	◎

Note : The figures are typical, and not the guaranteed value.

Composite stranded wire is employed as the center conductor

In TACHII's TCX-5DFWS newly developed, our original **composite stranded conductor** has been employed as the center conductor, in similar way with 5CFWS (the mobile coaxial cable developed for SDI signal). Because of this, the loop resistance can be reduced by making the cross-section area abt. 10% increase comparing with normal stranded conductor. As the result, the max. transmission distance could be greatly increased in digital microwave link transmission.



Max. transmission of distance in actual digital microwave link

In digital microwave link transmission at actual hookup point, 300m is used to understand that is maximum number of distance limitation by 5D-2W conventionally used coaxial cable. But, it is often the case that the hookup point cannot actually operate by 300m when adding to connection status of connector and aged deterioration of cable. It used to generate a big anxiety at the hookup point even if 300m transmission materialized.

TACHII surveyed the maximum number of distance in actual digital microwave link transmission by ourselves, and made the report as per the following graph. These figures should be understood as the measurement example only and were not guaranteed value by system maker. It is necessary to confirm respectively the transmission distance again when higher system of transmission distance capacity is developed.

Max. transmission distance example between the control unit and head unit in digital microwave link system (Sending)

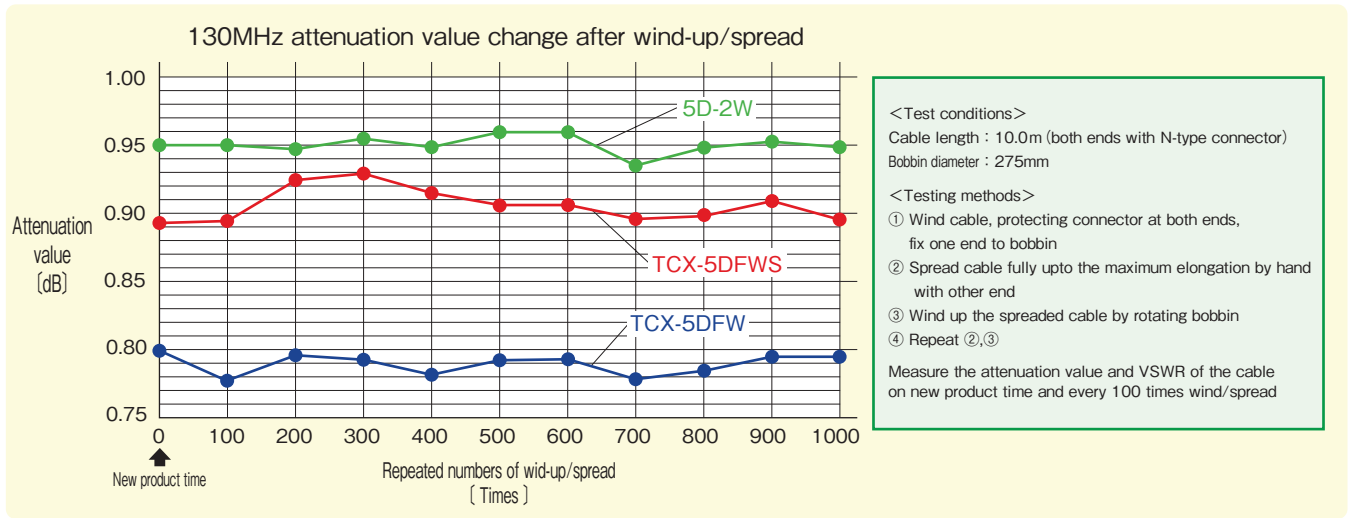
Coaxial cable	System maker	Max. transmission distance			
		0m	300m	400m	500m
General 5D-2W	In general		300m (Reference)		
TCX-5DFWS	A				450m
	B				410m
	C				460m
TCX-5DFW	A				500m
	B				450m

Note : The figures are results in our measuring examples, and do not mean any guarantee by system makers and us.

Tachii has succeeded to greatly increase the max. number of distance to more than 400m with **TCX-5DFWS**, more than 450m with **TCX-5DFW**, comparing with conventional 5D-2W. Judging from the actual operation, the cable is oftenly used on the basis of 100m, 50m, in some cases 25m, each cable operational distance is about 275~300m with 5D-2W, about 350~400m with **TCX-5DFWS**, about 400~450m with **TCX-5DFW**, as one of the standards. Prior to the actual employment by digital microwave link system, please be advised to measure maximum number of distance without fail and then use the cable with the distance about 25~50m shorter than measurement result.

Cyclic test for wind-up/spread

TACHII made cyclic test of digital microwave link use coaxial cable for wind-up/spread to winding bobbin, as realistic usages. The 130MHz attenuation values of IF signal were measured on new product time and every 100times wind/spread. The result was as graphed below, the attenuation deterioration caused by mobile was not confirmed. For VSWR change in up to 1GHz, every cable scarcely changed, the stability could be confirmed.



Digital microwave link cable for anchoring to facilities

The requirement was increased to make digital microwave link transmission distance more longer even in cable for facilities like mobile usages. 8D-2W was oftenly used for facilities so far. The transmission distance was understood as 450m after switching to digital system, the distance was not enough as microwave link system purpose for big facilities like dome stadium for baseball and soccer etc. and as a result many limitations were reported in view of the distance between O.B. van to relay terminal board in the facilities. To settle these problems, TACHII developed TCX-8DHF BW(PE) and perfectly materialized ultra long distance digital microwave link transmission for anchoring exclusively to the facilities.

Comparison between TCX-8DHF BW(PE) and conventional 8D-2W

	8D-2W Commodity actually measured		TCX-8DHF BW(PE)
Cable O.D.	12.4 mm	Equivalent level	12.5 mm
Cable standard weight (per 100m)	25.9 kg	abt. 3% Lighter	24.9 kg
130MHz standard attenuation value to become IF signal (per 100m)	7.3 dB	abt. 39% Improved	4.4 dB
Standard loop resistance between center conductor and outer conductor	7.33 Ω / km	abt. 39% Improved	4.46 Ω / km
Weatherability on outdoor use	× (Gray PVC sheath)	Use material for outdoor only	☉

Note : The figures are typical, not guaranteed value.

TCX-8DHF BW(PE) is exclusively employing polyethylen sheath which has been actually used outdoor purpose more than 20 years in order to minimize deterioration even in outdoor wiring for long term. This cable is very strong in weatherability against ultraviolet and winds/rains and keeps the characters as coaxial cable for long time. TACHII has been trying our very best to provide transmission distance as long as possible and also to keep the highest reliability.

Max. transmission distance example between the control unit and head unit in microwave link system

Coaxial cable	Sending/Receiving	System maker	Max. transmission distance
TCX-8DHF BW(PE)	Sending	In general	450m (Reference)
		A	950m
		B	750m
	Receiving	A	1025m min.
		B	800m
		C	1025m min.

Note : The figures are results in our measuring examples, and do not mean any guarantee by system makers and us.

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Coaxial cable production

Return loss management

TACHII has been producing coaxial cable, lineup for 3G-SDI, HD-SDI transmission in accordance with our internal specifications to manage the return loss lower. In actual, TCX-HD series, TCX-FWS series, TCX-FBL(FB) series have recorded the return loss as 20.9dB min. (~3GHz), this means more than 91% of the sending signal can be transmitted.

This specification has sufficient margin as return loss management figure at both sending/receiving terminals and can be easily compared with the specifications of SMPTE 424M(3G-SDI), SMPTE 292M(HD-SDI). In actual transmission among equipments, this is our reaction to safely send the signals for the better return loss management, in consideration of getting worse at the connector and patch panel connection when one cable oftenly going through by J-J connector to video-patch panel more than once with several coaxial cables in transmission.

The right-hand graph shows the sample image of the monitoring system using Fourier-transform analysis for total inspection of return loss on the production process of coaxial cable insulator. The system can do total inspection and monitoring of the return loss value in the designated frequency band.

As long as homogeneous form shaping on the core molding is obtained, very low and stable value of the return loss shall be shown. Of course, the deterioration of return loss value against the frequency maybe happened in the central conductor production process and brading process etc. TACHII's accumulated know-how has been exercised in the respective process. TACHII, as the specialized manufacturer of coaxial cable, shall continue our very best effort so that TACHII can be the most reliable supplier for our customers.

Return loss management system by the Fourier-transform analysis

The wave pattern in the right-hand graph shows the changes of electrostatic capacitance on the extrusion of insulation core forming. The changes are processed by computer on Discrete Fast Fourier Transform (DFFT), the return loss of insulator core is displayed in real time under the graph. The return loss has been always monitored whether the cable has been produced within the sufficient level against the specifications by inputting the designated value internally specified by cable model wise.



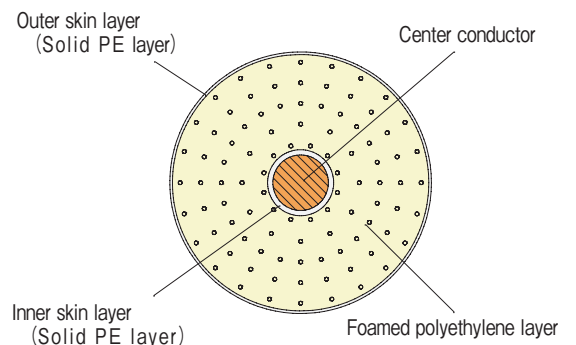
Sample : TCX-5CHD foamed insulator core production

3-layer structure - Foamed core production technology

TACHII has totally employed the force nitrogen gas foaming system under high pressure into polyethylene resin in the process to produce foamed polyethylene insulation core for TCX series Coaxial Cable, and also blended polyethylene resin by our original ratio of high density polyethylene (HDPE) with low density polyethylene (LDPE) for the most suitable cable design and production, in order to meet to the signal types, cable usages and operation systems.

The skin layer (solid polyethylene layer) is respectively set at the central conductor side and the outer circumferential of foamed insulation as the foamed insulation structure. It is vital and indispensable structure for skin layer to adhesiveness between conductor and foamed insulator and to stabilize foamed polyethylene molding. As a mater of course, the molding stability directly dictates the stable return loss.

Coaxial cable with 3-layer structure foamed core cross section area



About our policy for hazardous substances to the environment

TACHII has been certified by ISO14001 since January, 2003, aiming to "Earth-friendly manufacturing" under the environment protection movement. In addition, TACHII has been manufacturing by using X-ray fluorescence spectrometer etc. in accordance with RoHS Regulations set in July, 2006.

X-ray fluorescence spectrometer made by SII Nanotechnology SEA1000AII



RoHS Regulations

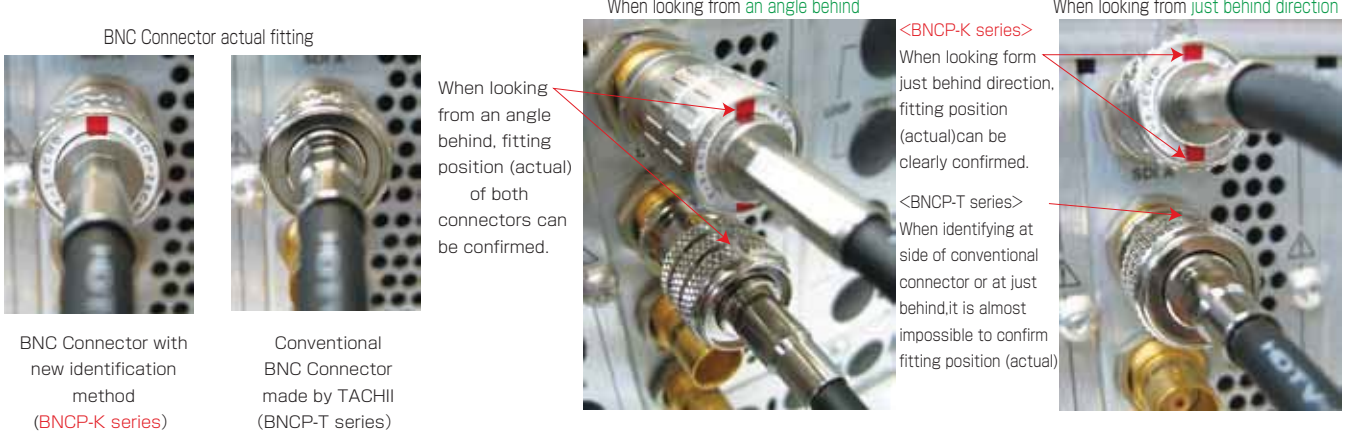
Restriction of the use certain Hazardous Substances in electrical and electronic equipment in European Union

RoHS Regulations substances and threshold values as of May, 2011

Controlled substances	Threshold value
Cadmium	100 ppm
Lead	1000 ppm
Mercury	1000 ppm
Hexavalent Chromium	1000 ppm
PBB	1000 ppm
PBDE	1000 ppm

※ Some substances are exempted.

New fitting confirmation for BNC Connector



Although so many equipments in broadcasting stations are connected by millions of cables and connectors, all the expected functions can be properly worked when the cables have been certainly connected. If by any chance, any connector has not been surely fitted, such situation shall definitely cause accident in broadcasting.

TACHII has materialized to more surely confirm the fitting than ever before by pasting TACHII's original identification seal to the specialized BNC Connector, developed by us for our coaxial cable TCX series only and made by KINGS.

Previously, it was the actual situation that, in the identification line at the side of connector (BNCP-T series), the fitting could be confirmed from an angle behind of the connector, however it could not be confirmed from just behind direction and therefore the expected performance could not be fully worked. For example, most connectors densely wired in the rack could be looked at just behind direction only. It was actually impossible to confirm from an angle behind.

The new BNC connector (BNCP-K series) has been produced to make it revolutionarily easy to confirm the fitting whichever looking from an angle behind and just behind. In addition, the identification color has been unified by series wise, the connector model number with adaptable cable name have been printed so that in actual connector processing field, different size connector mistake can be avoided when possible and the adaptable cable can be quickly found. With reference to identification seal availability and details of mark color, please check at the list on page 19.

(Note) The final fitting confirmation of connector must be surely done by your hand or tool, the locking position confirmation is purely as a guide.

Improvement of reliability for the BNC Connector, crimping type

BNC Connector [BNCP-T series] has been in the market for our coaxial cable [Specialized for TCX series]. [BNCP-T series] have been excellent so far for HD-SDI transmission, in view of VSWR character and mechanical structure. TACHII has jointly developed new BNC Connector [BNCP-K series] with KINGS in U.S. in order to completely correspond to 3G-SDI transmission and get the higher reliability by inheriting the above characteristics.

We have materialized VSWR 1.1 max. at 3GHz or less (except some product). We have totally employed Teflon insulator structure originally developed by KINGS to fix surely center contact keeping absolutely still, as well as to materialize low reflection property by VSWR of course. In actual comparison with center contact shape, it can be noticed to surely fix the center contact in extremely wide range on Teflon insulator comparing with used commodities in broadcasting stations. In addition, [BNCP-K series] can totally fix crimping part of center contact (right side of contact in photo below) perfectly with Teflon insulator. Namely the structure is designed, in order not to cause any movement, to completely contain with Teflon insulator, excepting the center contact edge part. As a result, the contact connection is dramatically stabilized when connected and the transmission block can be prevented.

Comparison of center contact shape



In locking structure of center contact in [BNCP-T series], the favorable comment has been given for "snap" contact (clicking feeling), which clearly identify the work, when inserted perfectly on center contact to connector itself. In order to make sure the perfect locking, we have also employed the improved system to [BNCP-K series]. The feeling on insert, is greatly different by the angle at the above salient cone part and its size. The center contact gives uncomfortable feeling when actually passing through Teflon insulator, no feeling is confirmed at the time of the conical part being out of Teflon insulator, and then the clicking feeling on perfect locking can become noticed, same as in [BNCP-T series], because locking is finished.