



CONNECTIVITY
FIREREPEATER
MIL 1394



PRODUCT FAMILY OVERVIEW:

The FireRepeater product family from DapTechnology was developed to overcome typical interconnectivity challenges when working with Mil1394 bus systems. Over the years DapTechnology has provided the industry with a large variety of products targeted mainly at addressing the following issues:

Cable length is limited:

In Mil1394 the usable cable length very much depends on the cable types transformer coupling, cable gauge and transmission speed. Even though the usage of active transformer coupling increases the line drive compared to regular IEEE-1394, the attainable cable length is still limited (see chart).

Connector and cable mismatch:

Due to usage of legacy equipment a variety of connector interconnects are used in the market. Often even legacy IEEE-1394 cables are in the mix creating a rather undefined network connectivity scenario with unclear signal attenuation. It is not recommended to simply couple an IEEE-1394 cable with a Quadrx cable.

Electrical isolation:

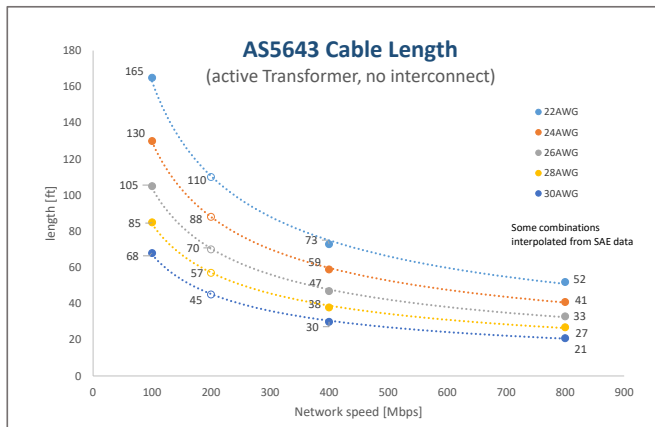
Sometimes the nodes on a bus have to be completely isolated. A real-world example is when a device under test (DUT) is placed in an EMI chamber for testing purposes, or when a device is placed in very close proximity to high EMI noise emitting devices (e.g., jet engines). In such cases the propagation of disturbances over the copper interconnect must be avoided. If the 'noise' levels exceed the isolation capabilities of the transformers then often only isolation using optical wiring can overcome this situation. However, typical Mil1394 equipment does not support optical media and therefore requires a media conversion.

Missing devices:

When building complex networks - like aircrafts - not all devices are always readily available. In order to ensure basic communication, it is often enough to substitute these 'missing devices' with physical layer - only devices thus providing the lowest level of interconnectivity.

PHYSICAL LAYER(S):

Developed specifically for the use in avionics programs AS5643/1 - S400 Copper Media Interface Characteristics specification defines the physical medium for cables on aircrafts. It defines precisely the usage on active transformer coupling, specific cables (ideally Quadrx by W.L.Gore). Together with commercial PHY layer silicon and typical line drive capabilities the maximum cable lengths between two bus nodes are limited and defines in the following chart:



This situation is accentuated by cable interconnects further reducing the usable length and related derating factors. Consequentially, covering a specific distance often is not possible with just a single cable. This can be overcome by using a different cable with a larger wire gauge, reducing the transmission speed and/or going to a different cable medium in the first place. All of which are often not possible within the confinements and restrictions of a specific A&D program.

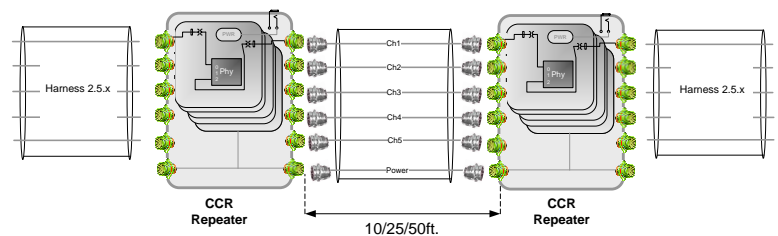
The solution to this is the addition of one or multiple inline repeaters or, alternatively, the conversion to another transmission medium. As all repeaters include a fully functional PHY layer device, the degraded signals are reconditioned and retransmitted on all connected ports thus allowing for another cable run. AS5643 transmissions protocols are designed to deal with the additional bus nodes which are added to the network and do not cause a problem (as long as the total node count per bus stays below 63).

Within the FireRepeater series DapTechnology uses commercially available PHY silicon (TSB41BA3) in order to provide the same physical layer as most commonly used in A&D programs. However, with increasing node count the required real estate increases (housing, components, ...) and there drives up the price as well as the usability.

At a node count exceeding 16 DapTechnology advises to consider an IP solution in which case DapTechnology will deploy its FireGate IP solution for the physical layer. With the ability to run many instantiations (only limited by FPGA resources) in parallel such repeater can easily address multi-channel repeater needs and enclosures are then mainly defined by connectivity requirements. Another consideration for using FireGate in high-end repeaters is the possibility to increase the port count per node. While commercially available silicon limits the port count to 3, IP based PHY layers can increase this number to 16, i.e., the limit defined by IEEE-1394. Such an implementation would favor building "hubs" with very high port counts.

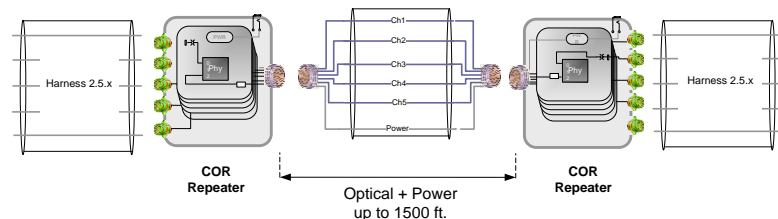
SINGLE & MULTI-CHANNEL

The number of channels depend entirely on how many bus connections have to be "extended". In the past DapTechnology has built solutions ranging for one (1) to twelve (12) channels. As mentioned above there is really no limit and as depicted below can be very effectively used to bridge larger distances for multiple buses.



MEDIA CONVERSION

When the distance becomes too long it might be better to convert the copper connection into optical fiber (glass).




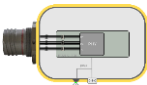

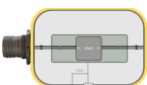

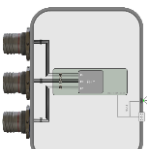

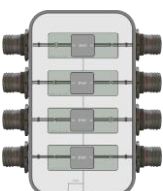

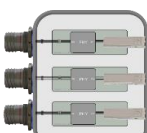

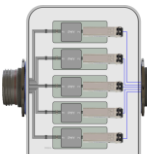

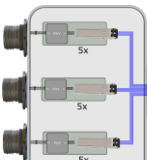

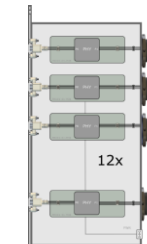
Other reason why media conversion can be helpful:

- extreme noise (EMI, acoustic, ...) exceeding the isolation limits of the transformer coupling. This can be the case if devices are very close to engines, etc.
- EMI testing: if one side of the system is located in an EMI chamber the systems can be properly "isolated". For related applications DapTechnology has built EMI-hardened systems optionally also for rechargeable Li-ion batteries.

COMMON MODELS:

The following FireRepeater models are part of DapTechnology's standard COTS product portfolio and have been sold on large quantities into various industry segments. All models shown below can be customized to meet specific needs.

Please visit our web site for latest additions to DapTechnology's growing list of standard FireRepeater models.

 <p>P/N: FR-LM13-00</p>		<ul style="list-style-type: none"> • 1Ch-LRU • Node Replacement • Copper (D38999)
 <p>P/N: FR-RM12-02</p>		<ul style="list-style-type: none"> • 1Ch-Repeater • Copper (D38999) • Inline • D38999 PWR
 <p>P/N: FR-RM13-01</p>		<ul style="list-style-type: none"> • 1Ch-Repeater • Copper (D38999) • Node Replacement • D38999 PWR
 <p>P/N: FR-RM42-01</p>		<ul style="list-style-type: none"> • 4Ch-Repeater • Copper (D38999) • Inline • D38999 PWR
 <p>P/N: FR-CLP32-01</p>		<ul style="list-style-type: none"> • 3Ch-Media Converter • Copper (LEMO) ↔ Optical (LC) • DIN rail mountable • LEMO PWR
 <p>P/N: FR-CLP52-01</p>		<ul style="list-style-type: none"> • 5Ch-Media Converter • Copper (D38999) ↔ Optical (D38999) • EMI hardened
 <p>P/N: FR-CMMF2-01</p>		<ul style="list-style-type: none"> • 15Ch- Media Converter • Copper (D38999) ↔ Optical (D38999) • EMI hardened • Li-Ion Battery PWR, rechargeable
 <p>P/N: FR-ABMC2-01</p>		<ul style="list-style-type: none"> • 12Ch-Media Converter • Copper (D38999) ↔ Copper (1394b) • 19"-rackmount • D38999 PWR

CONNECTORS & PINNING:

Even though *AS5643/1 - S400 Copper Media Interface Characteristics* clearly specifies the use of D38999 connectors for aircraft connectivity a lot of ground-based test, simulation and verification equipment uses either legacy 1394 connectivity or proprietary interconnects.

D38999: Unless specified differently DapTechnology uses D38999 connector pin assignments (standard or alternate) as recommended in the *AS5643/1 - S400 Copper Media Interface Characteristics* specification.

D38999/.....: Default Pin Assignment (standard)

Pin	Shell Size A (1 bus)	Shell Size B (3 buses)	Shell Size C (5 buses)
1	Port1 RX+	-	Port1 RX+
2	Port1 RX-	Port2 RX+	Port1 RX-
3	Port1 TX+	Port2 RX-	Port1 TX+
4	Port1 TX-	Port2 TX+	Port1 TX-
5	-	Port2 TX-	-
6	-	Port1 RX+	Port2 RX+
7	-	Port1 RX-	Port2 RX-
8	-	Port1 TX+	Port2 TX+
9	-	Port1 TX-	Port2 TX-
10	-	Port0 RX+	-
11	-	Port0 RX-	Port3 RX+
12	-	Port0 TX+	Port3 RX-
13	-	Port0 TX-	Port3 TX+
14	-	-	Port3 TX-
15	n/a	-	Port5 RX-
16	-	-	Port5 RX+
17	-	n/a	Port4 RX+
18	-	-	Port4 RX-
19	-	-	Port4 TX+
20	-	-	Port5 TX-
21	-	-	Port5 TX+
22	-	-	Port4 TX-

All pin assignment can be modified in order to meet program specific pinning should it differ from AS5643/1. Please contact our sales associates, then will gladly walk you through the process.

1394 Bilingual socket: pin assignment as per IEEE-1394; mates with both Beta and Bilingual cable harness plugs

LEMO Socket: receptacle for Circular Push Pull Connectors

SFF socket: SFF- 8614 with proprietary modifications for IEEE-1394

Optical LC: Snap, 1.25mm, IEC 61754-20

MEDIA CONVERSION:

Currently, DapTechnology support both copper and optical (glass) media as well as the conversion between the two.

Copper:

- standard IEEE-1394 cabling
- Gore QuadraX cabling (22 – 30 AWG)

Glass Fiber:

- 50/125 Multimode Duplex LC




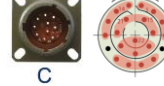




















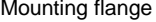

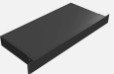
REPEATER POWER:

Due to their active components all FireRepeater variants require a power source (10 – 32 VDC). Power can be provided either locally by the customer (Dap will provide the adequate info. about power requirements as well as type and pinning of the power connector) or via an optional external power supply.

Repeaters can also be configured as power pass through allowing power be run alongside the bus cables via a separate wire.

CUSTOMIZATION OPTIONS:

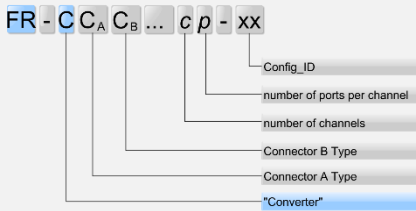
For all FireRepeater models DapTechnology offers a large number of configuration and customization options. Since we use basic building blocks, we can effectively scale the number of repeater channels, use different connectors as well as form factors without complex and time- as well as resource intensive redesigns. The approach has proven to be effective and delivers a great balance between cost, lead time and functionality. The following list shall be seen as a guide and the combination of options needs to be verified with Sales.

Channel number(s)		1 - 32					
Ports per Channel		1 - 3					
Connectors	 D38999 ("M"/"N")	Type, Medium	Socket (wall mount), Copper / Optical				
		Shell-Size	 A	 B	 C		
		Gender	 Pin	 Socket			
		Pinning	Mil1394 compliant		Customer defined		
		Plating	 Nickel plated		 Olive drab		
		Keying	 N	 A	 B	 C	 D
		Accessories	 Dust cap & Lanyard				
 IEEE-1394 (B")	Type	Bilingual female socket (wall mount), Copper					
	Pinning	IEEE-1394 compliant					
	Keying	Beta					
	Other	n/a					
 LEMO ("L")	Type, Medium	LEMO female, Copper					
	Pinning	Dap proprietary		Customer defined			
	Keying	n/a					
	Other	n/a					
 SFF ("F")	Type	female socket (PCB mount), Copper					
	Pinning	Dap proprietary		Customer defined			
	Keying	n/a					
	Other	n/a					
 LC ("P")	Type, Medium	female socket (PCB mount), Optical					
	Pinning						
	Keying						
	Other						
Enclosure	 Diecast	Material/Dim.	Aluminum, depends on channels count				
		Keying	 Yellow enamel	 Orange enamel	 Black powder coating	 unfinished	 other
	Other	 Mounting flange					
	 Profile	Dimensions	depends on channels count				
 Rack mount	Dimensions	1U rack unit, mounting flanges					
Power	provided by user	Input: 10 – 32 VDC 1.5W per channel	Connector example:		D38999/20FB2PN 1: GRND 2: VDC		
	AC/DC PWR Supply	typically 12 VDC 220/110VAC Wattage will depend on channel count					

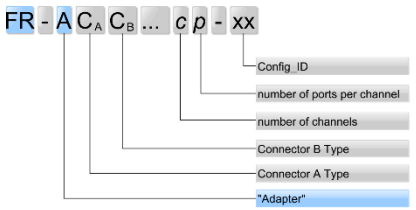
FIREREPEATER TYPES:

Due to the different usage models of repeaters DapTechnology devised the following different types of repeaters and all of them can be built in single as well as multi-channel configurations. All models are part of DapTechnology's standard COTS product portfolio and have been sold on large quantities into various industry segments.

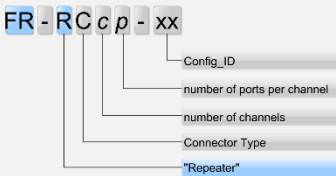
Converter - converts a specific media M_x type (Copper, POF, GOF, Wireless, ...) to one or more others of different types using different connectors (C_x):
 $M_A \neq M_B \neq M_C \neq \dots$, $C_A \neq C_B \neq C_C \neq \dots$



Adapter - adapts one connector type (C_x) to one or more others of different type on the same media (M_x):
 $M_A = M_B = M_C = \dots$, $C_A \neq C_B \neq C_C \neq \dots$

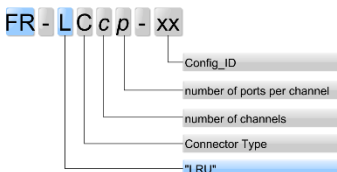


Repeater - repeats signals from one medium (M_x) to one or more connectors C_x of the same type. Always has more than one connector per node.
 $M_A = M_B = M_C = \dots$, $C_A = C_B = C_C = \dots$



LRU - exposes two or more ports (P0, P1, P2, ...) of one or multiple node(s) within single connector per channel:

$M_A = M_B = M_C = \dots$,
 $C_A(P_n) = C_B(P_n) = C_C(P_n) = \dots$



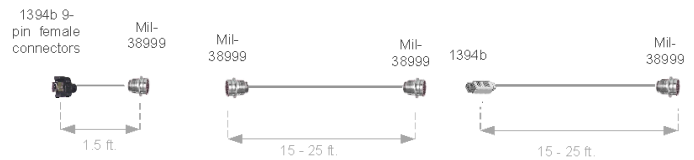
FEATURE SUMMARY:

- AS5643 compliant
- IEEE 1394b-2008 compliant
- Supported Speeds*: S100B, S200B, S400B
 *) depending on specific model
- independent 1394 nodes
- PHY Layers: TSB41BA3
- active transformer-coupled Mil1394 ports (copper)
- 48 months limited warranty

HARNESSES:

In support of the FireRepeater product family, DapTechnology offers a variety of cable harnesses targeted at the integration directly into the customer's project. These harness are entirely customizable with regards to number of channels, length, wire gauge, connectors, etc. Please discuss options with our sales specialists.

Below are just a few examples that can be assembled in multichannel harnesses:



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