

Yaesu DR-1X Repeater and Digital Voice Systems



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Topics

- Digital voice description: C4FM and others
- Technical comparison of modes
- DR-1X repeater overview
- Operational features of repeater
- WiRES-X / HRI-200 - Linking
- Fusion radio features
- Q/A

Tech Spec Comparison

	D-STAR	DMR	Fusion
Vocoder (see note)	AMBE+	AMBE+2	AMBE+2
Forward Error Corr.	Voice Only	Voice Only	Voice Only
Modulation	GMSK	4FSK	C4FM
Multiplex Method	FDMA	TDMA	FDMA
Raw Transmission Rate	4.8 kbps	4.8 kbps x 2	9.6 kbps
Bandwidth	6.25 kHz	12.5 kHz	12.5 kHz
Channels supported	1	2	1
Standard Developer	JARL	ETSI	Yaesu

GMSK = Gaussian Minimum Shift Keying

4FSK = 4-level Frequency Shift Keying

C4FM = Continuous 4-level Frequency Modulation (+/- 900, 2700 Hz)

FDMA = Frequency Division Multiple Access (channels)

TDMA = Time Division Multiple Access (“slots”)

Note: Newer radios implement the vocoder in a non-DVSI DSP chip

Signal Readability

	FM	D-STAR	DMR	Fusion
Voice naturalness	Very Good Good	Good	Good	Narrow - Good Wide - Very Good
Signal noise	Varies	None	None	None
Sync robustness	N/A	Fair	Good	Good
Sync recoverability	N/A	Poor*	Best	Best

Fusion has two voice modes. Wide sounds slightly better than narrow. Same RF bandwidth - more bits for encoding speech.

Sync robustness is the tendency to fall out of sync

Sync recoverability is the ability to recover sync quickly

* Some non-ICOM repeaters add improved sync

The opinions shown here are highly subjective. Your opinion may differ.

Repeater “Connect-ability”

	D-STAR	DMR	Fusion
Talk locally	Yes	Yes	Yes
Link to another repeater	Yes	No	No
Multi-repeater connection	Reflectors	Talk Groups *	WIRES-X Rooms
Selection method	UR entry	Channel Dial	Room name or number
Direct Route to another (remote) ham	Yes	No	No (via reflector only)
Echo test	Yes	Yes	No**
Request link status	Yes	No	No***

* “Reflectors” in EU. Uses Brandmeister, MARC, DMR+ networks

** Can do echo using DV4mini on FCS reflectors

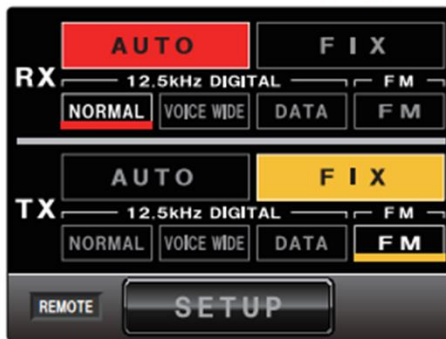
*** Yes - in analog mode #55555 if enabled

DR-1X Repeater - AMS

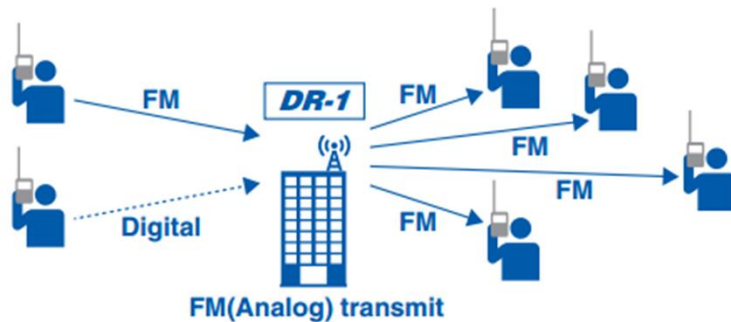
Replacing Existing Analog FM Repeater

When replacing an existing conventional FM repeater, AMS on the receiver side is set to AUTO mode and AMS on the transmitter side is set to FM FIX mode. If the DR-1 repeater receives C4FM Digital signals, it converts them, and retransmits them in conventional FM automatically.*² When receiving conventional FM signals it retransmits them unchanged as the FM repeater.

*² C4FM digital signals are converted to FM signals in the repeater. Therefore, digital information such as GPS data included in the C4FM digital signals is not transmitted.



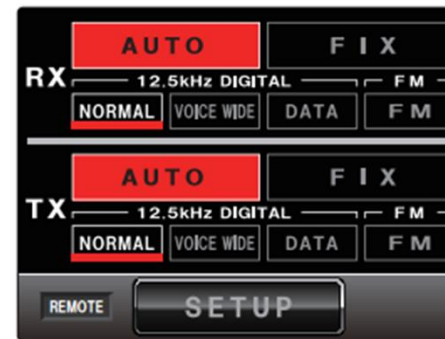
AMS receive → FM transmit



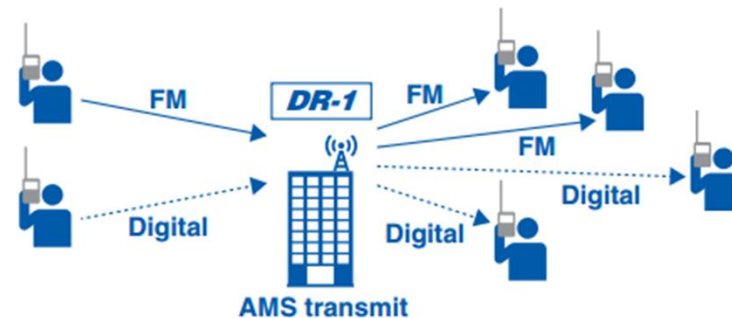
New Repeater set-up for C4FM Digital and conventional FM

AMS is set to AUTO mode on both the receiver and transmitter sides. DR-1 transmits received conventional FM signals unchanged as conventional FM signals, and transmits received C4FM digital signals unchanged as C4FM digital signals.*³

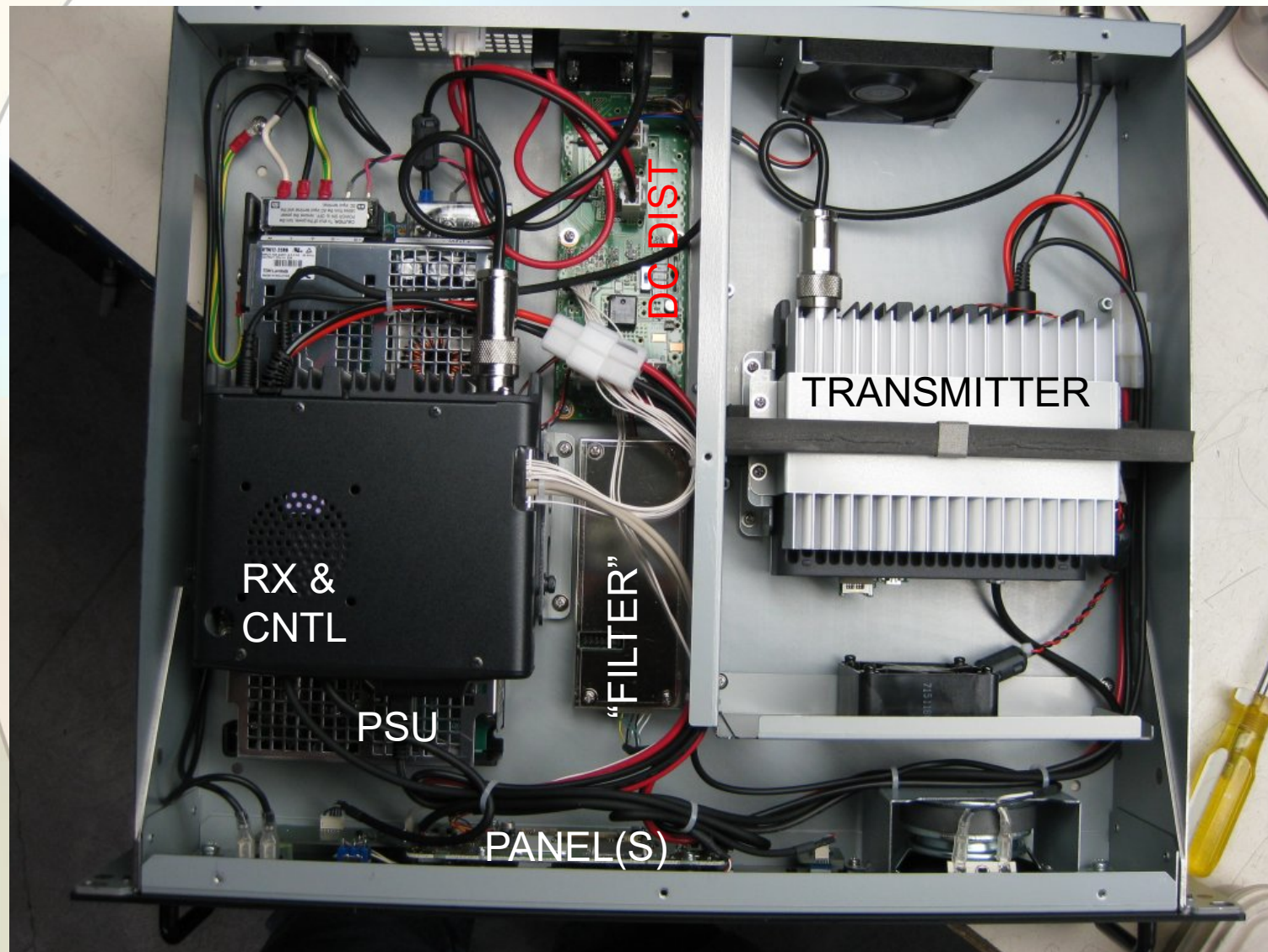
*³ When this setting is used, members using transceivers that are not equipped with the C4FM and AMS function cannot receive digital transmitted signals.



AMS receive → AMS transmit

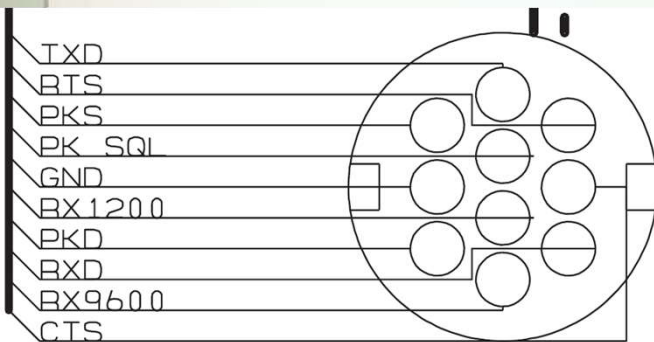
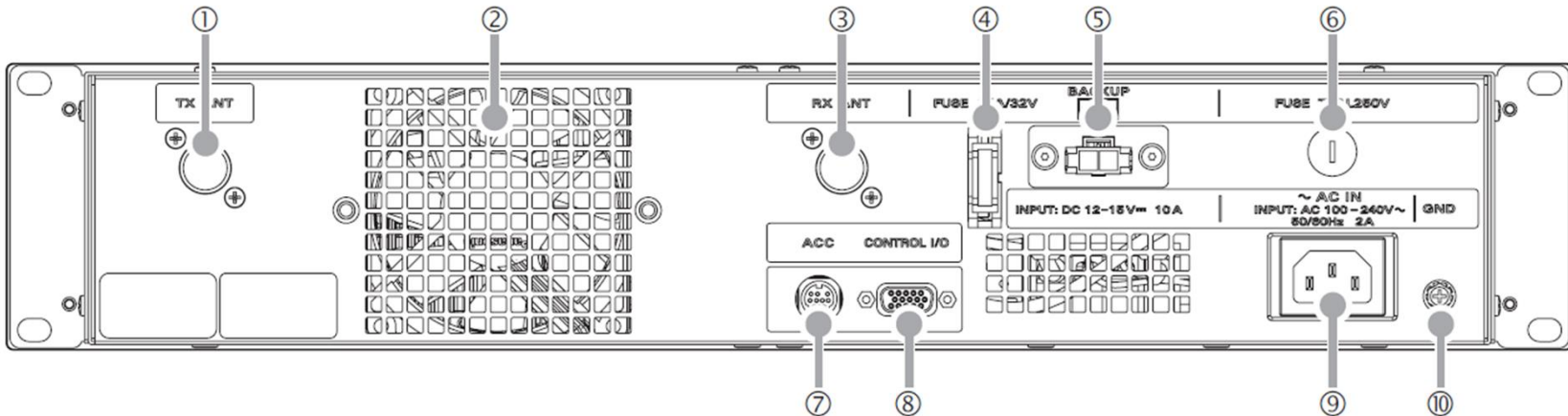


DR-1X Internals (Photo credit WA3DSP)



Back Panel / Interfaces

Rear



Used for WiRES
(HRI-200 Interface)
Can be used for DSTAR

Pin No	Pin Name	I/O	Operations
1	BASE	I	L: Base mode OPEN: Repeater mode
2	PTT*1	I	L: EXT PTT ON OPEN: EXT PTT OFF
3	CTCSS/DCS (PKSQL)*1	O	L: Decoded OPEN: Undecoded
4	SQL DET (Noise SQL)*1	O	L: SQL open OPEN: SQL close
5	GND	GND	GND
6	TONE IN*1	I	CTCSS/DCS EXT input / 600 ohm
7	AF IN*1	I	EXT Modulation input / 600 ohm
8	DISC OUT	O	Up-link RX Disc output (w/o de-emphasis)
9	AF OUT	O	Up-link RX AF output (w/ de-emphasis)
10	GND	GND	GND
11	EXT port 1*2	I	Determined by the signal combination of the port 1 and 2 as below:
12	EXT port 2*2	I	

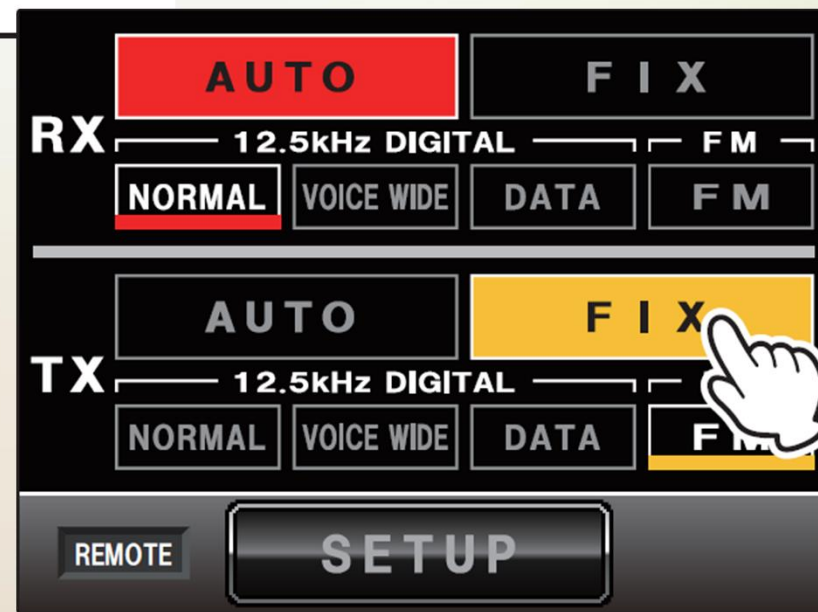
Port 2	Port 1	RX	TX
H	H	AUTO	FM
H	L	FM	FM
L	H	Digital	Digital
L	L	AUTO	AUTO

Modes of Operation

Communication mode	Indicator
V/D mode (Simultaneous voice and data communication mode)	NORMAL / DN
Voice FR mode (Voice full-rate mode)	VOICE WIDE / VW
Data FR mode (High speed data communication mode)	DATA / DW
Analog FM mode	FM

In AUTO mode, the repeater senses the mode of the incoming signal and changes to match. Users should enable busy-channel-lockout (BCLO or "Smart PTT").

In normal mode (DN) 2400 bps is used for AMBE speech encoding; remainder used for data and error correction.
In wide mode (VW) 4800 bps used for speech and 2400 for error correction.



WiRES-X – Key Points

Evolution of WiRES-II analog system - connects nodes

Separate network from WiRES-II - uses HRI-200 device (see below)

Network carries both “analog” and digital signals

A (small) PC needed for the WiRES program and network connection

WiRES interface itself must be analog or digital mode - no AMS

WiRES interface can connect to repeater aux port or a separate
“node radio”

Members organized as Groups, Nodes, “Rooms” (public and private)

Yaesu proprietary server in Japan (hot spots use non-Yaesu servers)

HRI-200



Transceiver

Operation mode

- Digital
Digital Operation(Voice CH only)
- Digital Dual Receive
Digital Operation(Dual Receive mode)
Dual Receive timing: 1sec
- Digital Double
Digital Operation(Double Transceiver control)
- Analog
Analog Operation(Voice CH only)

Voice CH			Preset Search CH		
Transceiver	DST	F/W version	Transceiver	DST	F/W version
FTM-100DUSA		1.2			

Modulation: Digital
 Frequency: 445.400 MHz
 SQL code: DSQ OFF
 Narrow Deviation
 C4FM detect: [Dropdown]
 Power: Mid
 Offset: +0.000 MHz
 Uplink (RX)=445.400MHz
 Downlink (TX)=445.400MHz
 Reverse
 Hide frequency settings

Operation: OFF
 Frequency: 445.400 MHz
 SQL code: DSQ OFF
 Narrow Deviation
 C4FM detect: [Dropdown]
 Power: Low

Sound

Playback Recording Sounds Communications

Select a recording device below to modify its settings:

- Microphone 2- High Definition Audio Device Ready
- Microphone 2- High Definition Audio Device Ready
- Line In 2- High Definition Audio Device Ready
- Microphone 2- HRI-200 A[CH1] USB Audio codec Default Device

Buttons: Configure, Set Default, Properties, OK, Cancel, Apply

Volume Mixer - Speakers (2- HRI-200 A[CH1] USB Audio codec)

Device	Applications
Speakers	System Sounds, WIREs-X, Sponsored session

Buttons: [Volume Sliders], [Mute Icons]

WiRES-X Control (TeamViewer)

YAESU-PC - TeamViewer - Free license (non-commercial use only)

WIREs-X

File(F) View(V) Connect(C) Tool(T) Help(H)

Actions View Communicate Files & Extras

NET DIGITAL ON-AIR INTERNET

---AMERICA-LINK

User = KE2N > ***** (DN-DIR)
Uplink = W4BRM (30049)

Room ---AMERICA-LINK(21080) member 58 nodes Refresh Close

W4BRM-ND KE2N Send Node : W4BRM-ND (30049) / Mobile : KE2N

K4EX-RPT	K5SBH-RPT	N5YX-RPT	KU5J-ND	VE2FTA-ND	WA3PNY-ND	W3ZIC-RPT	N4TIK-RPT	KF5YOT-ND	KOSXY-RPT
SCOTLAND	K3SL-VE2-R	VA7REF-RPT	VK5ZSW-ND	AAOX-RPT	N3JHS-BILL	KD6KHM-ND	K8KRG-RPT	VE5BBZ-RPT	K3MJW-RPT
W8OTC/R	K3DO-ND	ZL2FY-ND	VK6RPT	N2YN-ND	N3SCP-ND	KK4VZ I-ND	N3CAL-ND	KC1EKZ-ND	N9GZK-DAVE
N8VTU-NODE	WB4HRO-RPT	MB6ISR-GW	NA5AA-ND	KG5FEC	W8KRF-ND	KC4DV-ND	N5ETC-R-AR	VK4JPA-ND	K3IH-GARY
NK5CC-RPT	JA7UDE-OBA	WA7BND-RPT	NI4MX-RPT	AB9DW-ND	KW4YT-ND	KC0SKC-ND	2M0SBP-ND	KB7NZZ-ND	N4YKE-ND
W3QV-RPT	WOFEB-RPT	W3SDR-ND	KX0N-RPT	K9TSU-VHF	W4JAX/R	KC3JCS-ND			

Room ID	DTMF ID	-Act	Room name	City	State	C...	Comment
ALLJA-CQ-ROOM	20510	159	ALL JA CQ ROOM#1	Yamato-city	Kana...	J...	yCQf{fEz CQ, *
---AMERICA-LINK	21080	059	America Link N...	Beaumont	Texas	USA	America Link N
ITALY	27003	045	WIREs-X ITALIA	Cassolnovo	Lomb...	I...	WIREs-X ITALIA
---MNWIS-FUSION	21493	044	MNWis Fusion L...	Lino Lakes	Minn...	USA	mainly used fo
0382-ROOM	20382	042	WIREs-X 0382Room	Nagoya-city	Aichi	J...	WIREs-X in NAG
TSQLO945-ROOM	20945	027	fg[f^fXfP<f^`...	Koriyama-city	Fuku...	J...	WIREs-X , , , , ,
E-KYUSHU-ROOM	29118	022	~E~BQSORoom	Miyazaki-city	Miya...	J...	East Kyushu Ro
9158-ROOM	29158	020	9158zi-,if{fE	Itabashi-ku	Tokyo	J...	f [f^fu<fm[fh
JJ2YMZ-ROOM	22490	020	WIREsftfE^f^f...	Fuwa-gun	Gifu	J...	, , , , , , , , ,
TEAM0949-ROOM	20949	018	æ, Ì, b, p , q, ,	Souraku-gun	Kyoto	J...	, v, ð, q, d, r, h, h,
---FUKUOKA-LINK-	20587	016	FUKUOKA-LINK	Fukutsu-city	Fukuoka	J...	--C4FM/APRS 96
10M-FM-ROOM2	20463	015	10M-FM-ROOM-2	Kodama-gun	Saitama	J...	JJ1EJN,if{fE,
ALABAMA-LINK	28933	014	Alabama-Link	Troy	Alabama	USA	
LA-REPEATER	21042	014	So. Cal. Link N...	Mt. Wilson	Cali...	USA	Covering So. C
JH6YMX-ROOM	29090	012	Ž-Ž~+~ú0~'ú~ò...	Kagoshima...	Kago...	J...	Ž-Ž~+~ES~ú0~'ú
JAGYIY-ROOM	20852	012	'è@~ú0~'ú~òž'd'c	Nagasaki-city	Naga...	J...	'ú0~'èES~x~'~'~
-----UK-NET-HUB	27721	011	English Speaki...	Middlesbrough	Nort...	UK	UK WIDE REPEAT
JNET9	22512	011	JNET9	Tsuruga-city	Fukui	J...	
0202-ROOM	20202	010	APRS 9K6	Kitakyushu...	Fukuoka	J...	, , , , , , , , ,
OKAYAMA-0253	20253	010	JA 0253 QSO ROOM	Okayama-city	Okayama	J...	WIREs-X QSO Ro
PAX-RADIO-ROOM	20963	010	PaxRadio Frien...	Hachioji-city	Tokyo	J...	PaxRadioŠA %*%

2016/10/30 20:37:45 N4YKE-ND(30132) IN. 60
2016/10/30 20:38:59 VE1XK-RPT(18329) OUT. 5
2016/10/30 20:41:08 NODCA-SSC(30078) IN. 60
2016/10/30 20:41:21 NODCA-SSC(30078) OUT. 5
2016/10/30 20:41:57 KV7JPL-ND(30084) IN. 60
2016/10/30 20:42:00 Station info TX to V-CH
2016/10/30 20:42:57 NOAYK-ND(18412) OUT. 55
2016/10/30 20:43:01 KV7JPL-ND(30084) OUT. 5
2016/10/30 20:44:04 K9TSU-VHF(30095) IN. 55
2016/10/30 20:45:27 N8PBX-ND(18231) OUT. 56

2016/10/29 12:52:38 N5YX-RPT > ---AMERICA-LINK : T
2016/10/29 19:40:47 K3SL-VE2-R > ---AMERICA-LINK :
2016/10/29 20:14:31 WA3PNY-ND > ---AMERICA-LINK :
2016/10/29 20:18:51 N5YX-RPT > ---AMERICA-LINK : N
2016/10/29 20:38:01 VE3RNM-RIC > ---AMERICA-LINK :
2016/10/29 20:57:24 KB7NZZ-ND > ---AMERICA-LINK :
2016/10/29 21:02:41 W13J-STU > ---AMERICA-LINK : W
2016/10/29 21:03:04 W13J-STU > ---AMERICA-LINK : W
2016/10/29 21:07:07 AB8DT-RPT > ---AMERICA-LINK :
2016/10/29 21:10:19 KE8CQ-ND > ---AMERICA-LINK : K
2016/10/29 21:15:53 ---KOSTP-- > ---AMERICA-LINK :
2016/10/29 21:40:28 VK4JPA-ND > ---AMERICA-LINK :
2016/10/29 22:35:35 ACOYV-ND > ---AMERICA-LINK : h
2016/10/30 09:18:45 N2YN-ND > ---AMERICA-LINK : ph
2016/10/30 10:27:21 M8NAE-ND > ---AMERICA-LINK : G
2016/10/30 11:06:18 N2YN-ND > ---AMERICA-LINK :
2016/10/30 11:09:01 N4YKE-ND > ---AMERICA-LINK :
2016/10/30 14:28:09 N4YKE-ND > ---AMERICA-LINK :
2016/10/30 17:39:28 DBORTN-RPT > ---AMERICA-LIN
2016/10/30 17:42:45 N5YX-RPT > ---AMERICA-LINK

Connecting to a Local node

Enables menu items on Fusion radios

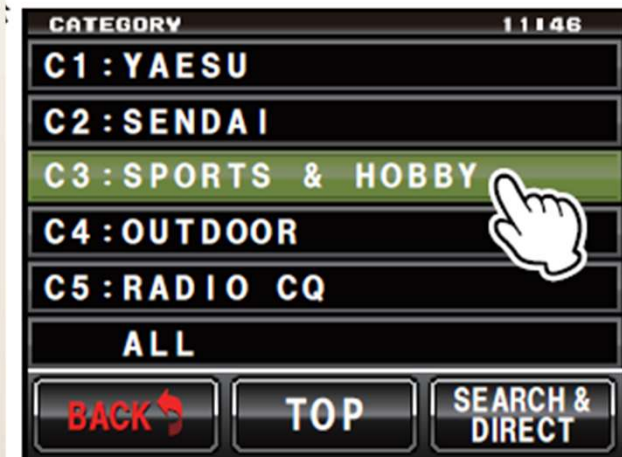
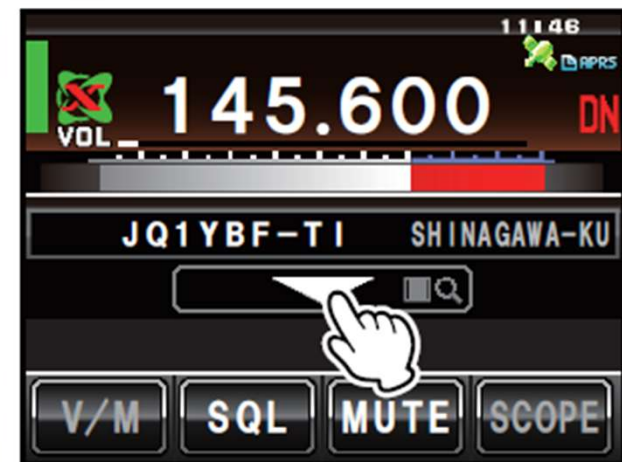
To connect, just push one button

(Same button selects modes when not linked)

Many features available in dig. mode:

- Location, name, call sign distance shown
- Viewing list of available rooms number of connections in room, searching, group mode (GM), etc.
- GPS Position data and tracking
- Messaging - text, voice, photo, APRS

Note: you can talk without connecting -
when you connect, radio is “captured”



WiRES-X Analog Linking

Node/HRI-200 must be in analog mode.

Your signal will be relayed to the linked remote node/room

No call sign or GPS info relayed. Digital stations will see repeater/node call.

DTMF commands can be used to change where the node is linked.

You can talk to digital users who are on a digital node (on a different node).

Non-fusion radio with DTMF mic can be used.

WiRES-II tone-burst from older Yaesu radios not used.

Summary

- Yaesu System Fusion combines analog + digital voice + data
- Uses improved vocoder (AMBE⁺²™) more error correction
- C4FM used by other vendors, but not compatible on the air.
- Ease of basic operation; fancy features are available
- Linking by way of WiRES-X network - or 3rd party reflector.
- HRI-200 can be attached to DR-1X, or standalone.
- With HRI-200, repeater *cannot* translate digital/analog
- Repeater is “transparent” to users (but does error correction).
- Promotional offer for DR-1x repeater - rebates for some radios

Questions?

Supplemental material/references follow...

ONE CLUB'S APPROACH

So I'm still analog and have no plans to buy a new radio, how will this affect my use of 44X.XXX repeater?

Normal FM users will be able to co-exist with new digital radio users. The Yaesu System Fusion DR-1X repeater will automatically select the proper incoming mode and pass normal analog traffic or the new digital traffic automatically.

Part of the test is the Fusion's ability to coexist with FM analog signals. FM users; just place your radio into full encode/decode to mask out any digital conversations. Please watch your busy light and hit your monitor button before transmitting.

Digital users are required to run their rigs in AMS (auto mode select) mode. That way an analog user can jump in and say 'break' in-between digi transmissions. When the analog FM user key's up the DR-1X repeater, this will normally force the DR-X repeater and other users listening in the AMS mode back over to regular analog FM.

References

Yaesu Fusion Manuals

DR-1X_S-COM7330_EH043U500.pdf

DR-1X_Technical_Supplement.pdf

DR-1X_w_HRI-200_1601-B0.pdf

DR-1_OM_ENG_EH043U101.pdf

FT2DR_GM_1506-A0.pdf

FT2DR_WIRES-X_1506-A0.pdf

FTM-400DR_DE_TS_USA_EXP_EU_EH034M90B.pdf

FTM-400DR_DE_WIRES_1510-D0.pdf

FTM-400XDR_DE_OM_ENG_EH034M210.pdf

FTM-400XDR_DE_QM_EH034M581.pdf

FTM-400-APRS-Manual.pdf

ftm100dr.pdf

Leaflet DR-1.pdf

WIRES-X_Manual_ENG_1606-E0.pdf

wires_ver3510e_rel01-HRI-100-manual.pdf

[Yaesu_Amateur Radio Digital Specs_1V02_EN-GB.pdf](#)

Some On-Line References

ARRL Product Review FTM-400 (DR1X repeater based on)

<http://www.qsl.net/kb9mwr/projects/dv/yaesu/Yaesu%20Analog-Digital%20Transceivers.pdf>

Other links

<http://www.charlottedstar.org/Comparison%20of%20Amateur%20Radio%20DV.pdf>

http://www.hamoperator.com/Fusion/FusionFiles/K9EQ-PRES-PDF-0001_Why_Digital.pdf

http://hamoperator.com/Hamoperator/WiRES-X_Bible/WiRES-X_Bible.html

http://hamoperator.com/Hamoperator/Fusion_Help.html

<http://ft2dr.blogspot.com/2015/03/ft2dr-and-400dr-questions.html>

http://www.dvsinc.com/manuals/AMBE-3000_manual.pdf

http://utahvhfs.org/freqfaq1.shtml#c4fm_bandwidth

Fusion/Wires-X user groups

<https://groups.yahoo.com/neo/groups/AmericaLink/info>

<https://groups.yahoo.com/neo/groups/YaesuSystemFusion/info>

DMR

<https://brandmeister.us/>

<http://hose.brandmeister.network/3104/>

<http://cbridge.k4usd.org:42420/MinimalNetwatch>

<http://www.dmr-marc.net/>

http://ham-dmr.de/?page_id=233&lang=en

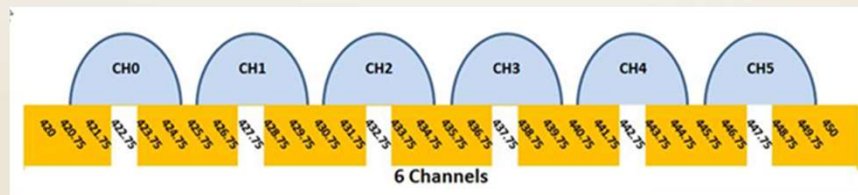
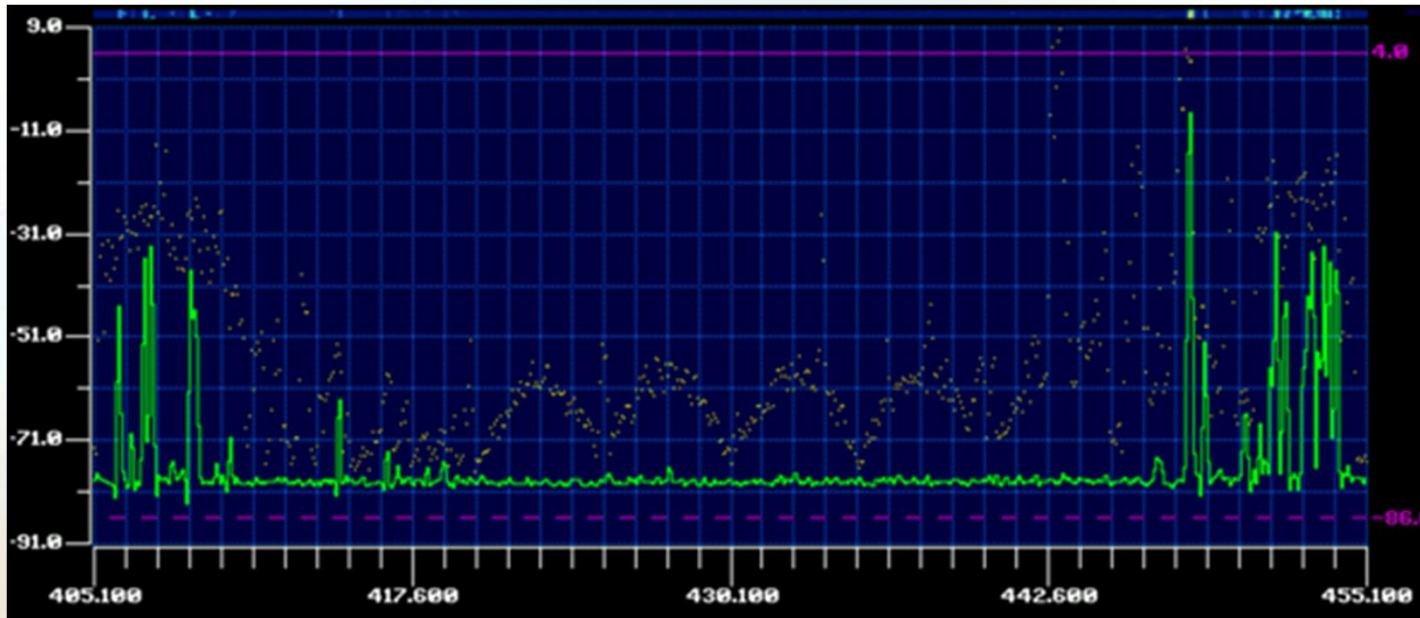
http://www.trbo.org/docs/Amateur_Radio_Guide_to_DMR.pdf

DSTAR

<http://nwdigitalradio.com/wp-content/uploads/2012/04/UDRCDS.pdf>

http://utahvhfs.org/dstar_channel_spacing.html

EPLRS QRM on 440



https://www.ntia.doc.gov/files/ntia/publications/compendium/0420.00-0450.00_01MAR14.pdf

System Fusion Mobile



- Yaesu - FT-400DR
 - Dual band
 - 50W
 - Automatic Mode Select
 - 1000 memories
 - GPS & APRS
 - Color Touch screen
 - \$600 new
- Yaesu - FT-100DR (new)
 - Dual band
 - 50W
 - Automatic Mode Select
 - 1000 memories
 - GPS & APRS
 - \$400 new



System Fusion HT's



- Yaesu - FT-1DR
- Dual band
- 5W
- Automatic Mode Select
- 900 memories
- GPS & APRS
- \$300 new



- Yaesu - FT-2DR (new)
- Dual band
- 5W
- Automatic Mode Select
- 1245 memories
- GPS & APRS
- Touch screen
- \$550 new



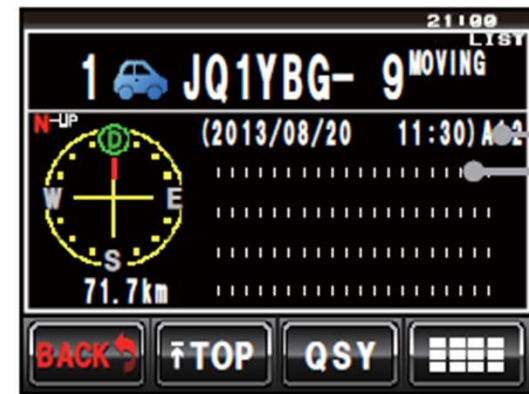
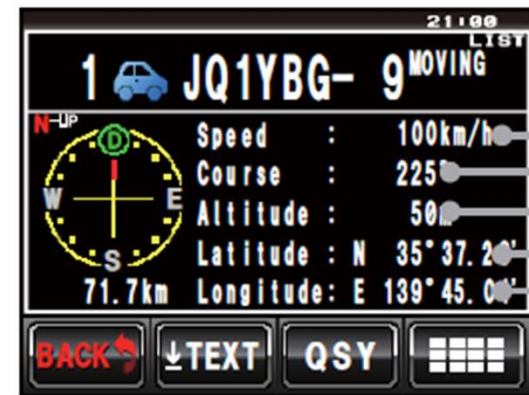
Base Station



- Yaesu - FT-991
- HF + 6M - 100W
- 2 & 70 cm - 50W
- Color TFT display
- Automatic antenna tuner
- Automatic Mode Select
- 1000 memories
- GPS & APRS
- \$1,600 new



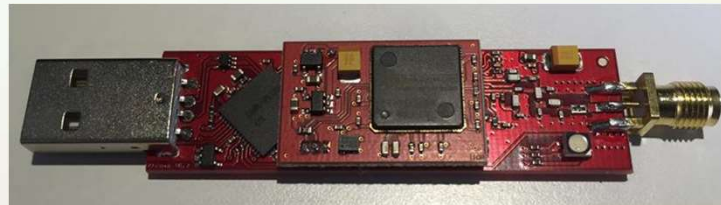
All Fusion radios feature extensive APRS functions



No repeater in range?



DV4mini with AMBE "piggyback"



DV4mini for D-Star, DMR, Fusion, APCO25, DPMR and other digital modes which are based on GMSK, 2FSK or 4FSK.

DV4mini – Control Program

DV4mini Control Panel (Stick ID: 9D-74-60 V201.73 @ 255.255.255.255) CPU 4 cores: 42 %

DV Control Expert Settings RSSI Reflector Info FW Update Info

Personal Settings
DMR/CCS7 ID: 3151457
Hotspot Callsign KE2N E
Location (City): Haymarket
QTH Locator: FM18EW
Internet Data Quality:

DV4mini Settings
 D-Star C4FM
 DMR+ P25
 DPMR NXD/DAS
Power: 0 5.5mW 12
RX-QRG: 445.5 MHz
TX-QRG: 445.5 MHz
SIMPLEX

C4FM Fusion
in use
FCS001 83
FCS002 84
FCS003 85
86
87
88
89
90

Info
WDSG
NSYX
disconnected
connected to FCS001-1
disconnected
connected to FCS002-00
FCS002
disconnected
connected to FCS002-90
disconnected
connected to FCS002-90
KB8A0B
NSYX
KB8A0B
KB8A0B
Message Calls Picture

S-Meter: -81 dBm

```
23:12:44,195 (0000): DV4mini ... Disconnect from C4FM/P25 Reflector
23:12:44,196 (0001): C4FM ... Disconnect from C4FM/P25 Reflector
23:12:44,196 (0000): C4FM ... Disconnected from C4FM/P25 Reflector
23:12:46,683 (2487): DMR ... DMR scanner: OFF
23:12:46,683 (0000): DV4mini ... Connect request to C4FM/P25/DPMR/NXDN FCS00290
23:12:46,684 (0001): C4FM ... Disconnected from C4FM/P25 Reflector
23:12:46,685 (0001): DV4mini ... KE2N E 3151457 F 445500000 445500000 qth:FM18EW town:Haymarket
23:12:46,685 (0000): ADF ... set RX / TX qrg: 445500300 / 445500300
23:12:46,685 (0000): DV4mini ... set mode: Fusion
23:12:46,718 (0033): ADF ... DV4mini Stick Msg: set 70m band
23:12:46,934 (0216): C4FM ... Connect to C4FM/P25 Reflector FCS00290
23:12:46,987 (0053): C4FM ... Connected to C4FM Reflector: FCS00290
23:12:47,186 (0199): DMR ... Set Dongle ID:#3151457/KE2N
23:12:47,186 (0000): DSTAR ... Connect CCS7-USA
23:13:22,469 (35283): DSTAR ... Connect CCS7-USA
23:14:25,851 (3382): DSTAR ... Connect CCS7-USA
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connected to FCS002-90 CCS7 KB8A0B

3rd-party Reflectors

xreflector.net/neu3/

DMRplus FCS002 Dashboard | Reflector Status and Control

Fusion Reflector System by DG1HT Status System v0.1 | FCS Server v0.1

HOME	Nr.	CALL	Last Heard	Name	Group
ircDDB Live	1	KE2N	3 s	America Link WIRE-S-X	90
Impressum	2	ND6C	13 s	SoCal Link Society	70
DCS Live <i>beta</i>	3	N0ANC	13 s	Minnesota	23
QTH locator?	4	KE4LTT	1 m 34 s	Alabama	02
HAM-DMR	5	N4HYK	1 m 52 s	TALK USA1	00
Hytera User	6	W7NHY	2 m 13 s	America Link WIRE-S-X	90
Hytera Live	7	KB8AOB	2 m 58 s	America Link WIRE-S-X	90
Fusion	8	KI7EIX	4 m 18 s	Alabama	02
FCS001	9	AD4DZ	5 m 5 s	Alabama	02
FCS002	10	W4NFD	6 m 19 s	Central Alabama	55
FCS003	11	W1KFR	6 m 41 s	SoCal Link Society	70
dPMR	12	N0EHQ	7 m 21 s	Alabama	02
LCS001	13	KT4ROY	7 m 49 s	Alabama	02
APCO P25	14	N4PHD	8 m 18 s	Central Alabama	55
PCS001	15	AB2BH	9 m 37 s	SoCal Link Society	70
DCS Multiserver	16	K4FDS	10 m 23 s	Alabama	02
User	17	WA6YVX	11 m 53 s	Minnesota	23
DCSMultiLink	18	KE4GA	12 m 21 s	Central Alabama	55
DCS Software	19	WD5G	12 m 43 s	America Link WIRE-S-X	90
DCS Monitor	20	KC8YQL	14 m 57 s	Georgia	11
CCS System	21	N2HUC	16 m 56 s	Florida	10
CCS Repeater	22	W4LOV	17 m 46 s	SoCal Link Society	70
CCS Monitor	23	K7DRA	20 m 55 s	Minnesota	23
User Register	24	KC4SIG	21 m 5 s	Central Alabama	55
CCS7-Info_DL	25	W4DBG	22 m 10 s	Alabama	02
CCS7-Info_ENG	26	W6AOS	23 m 23 s	America Link WIRE-S-X	90
Germany	27	N5ICK	23 m 47 s	Minnesota	23
DCS001	28	K9CRT	26 m 8 s	Illinois	14
User	29	WA9RTI	28 m 34 s	Illinois	14
Repeater	30	KP4TR	28 m 47 s	Wires-X Spain	75
Group info	31	W8UFO	29 m 21 s	SoCal Link Society	70
	32	N8VUA	31 m 1 s	Alabama	02

Improving Isolation in the DR-1X

