

(12) United States Patent Wu

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(54) DIGITAL SUBSCRIBER LINE MODEM INITIALIZATION

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- (73) Assignee: **Texas Instruments Incorporated**, Dallas, TX (US)
- (*) Notice:
 - This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

- (21) Appl. No.: 08/995,256
- (22) Filed: Dec. 19, 1997

Related U.S. Application Data

- (60) Provisional application No. 60/059,182, filed on Sep. 17, 1997.
- (51) Int. Cl.⁷ H03H 7/30; H03H 7/40;
- Н03К 5/159

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CENTRAL OFFICE MODEM 20k REMOTE MODEM 10 INIT REO ACTIVATION AND ACTIVATION AND INIT ACK -60C 60R ACKNOWLEDGEMENT ACKNOWLEDGEMEN TRANSCEIVER 62R-TRANSCEIVER -62C TRAINING TRAINING CHANNEL CHANNEL 64R 640 ANALYSIS ANALYSIS ÷ EXCHANGE EXCHANGE -66C 66R TO COMMUNICATION OF DATA

OTHER PUBLICATIONS

"A Discrete Multitone Transceiver System for HDSL Applications," Chow, et al., *IEEE Journal on Selected Areas In Communications*, vol. 9, No. 6, Aug. 1991, pp. 895–908.

"Multicarrier Modulation for Data Transmission: An Idea Whose Time Has Come," John A. C. Bingham, *IEEE Communications Magazine*, May 1990, pp. 5–14.

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(57) ABSTRACT

A method of initializing the operation of a remote modem (10) and central office modem (20_k) for asymmetric subscriber line modem communications over a twisted pair wire facility (TWP), using discrete multi-tone technology, is disclosed. The initialization process begins with the remote modem (10) issuing an initialization request, in response to which the central office modem (20_{ν}) issues an acknowledgment. The remote modem (10) includes a low-cost analog filter (21) for separating upstream communication echoes from downstream data. This analog filter (21) increases the duration of impulse response over the channel, and thus requires time-domain equalization (TEQ) process (31) performed by the remote modem (10) to filter relatively long circular prefixes, so that intersymbol interference is eliminated. Transceiver training processes (62R, 62C) are carried out, through the generation of a pseudo-random sequence of frames by the central office modem (20_{μ}) , the receipt of which is used by the remote modem (10) to establish its TEQ coefficients and taps in an optimal manner.

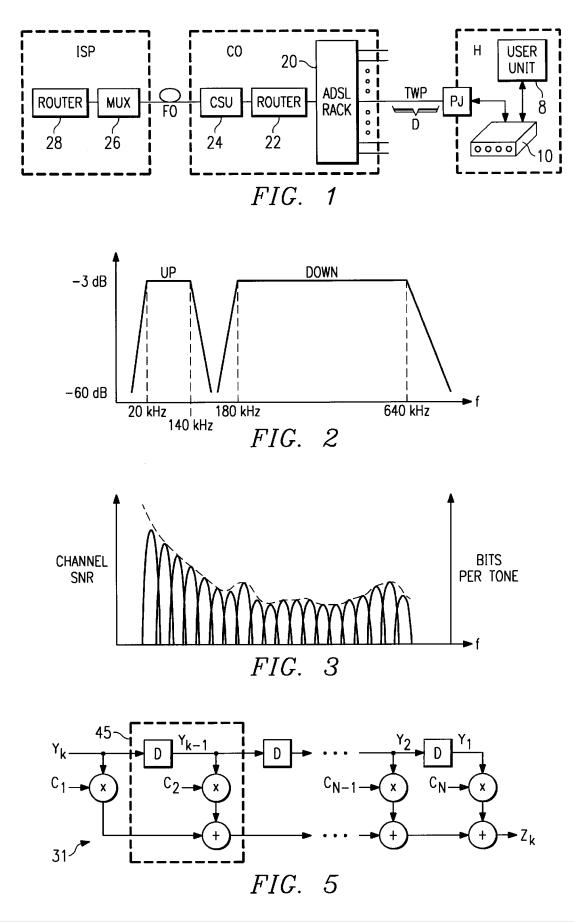
18 Claims, 5 Drawing Sheets

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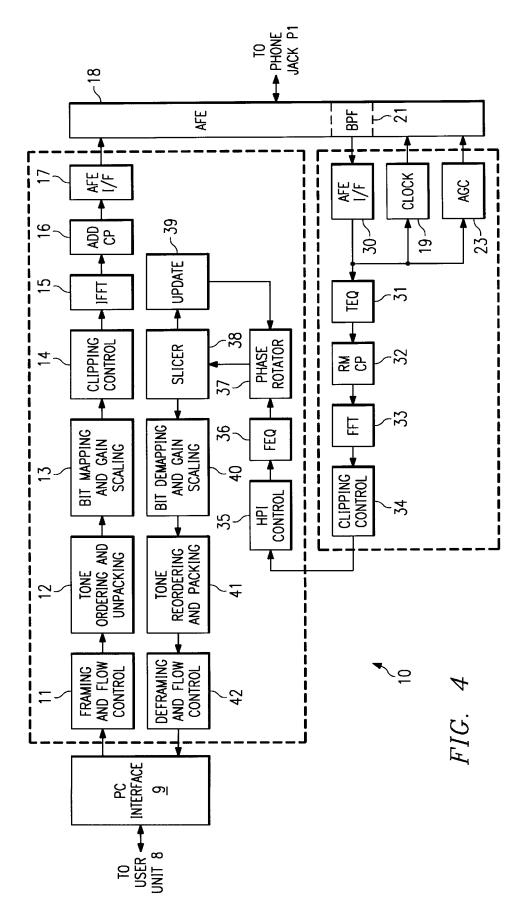


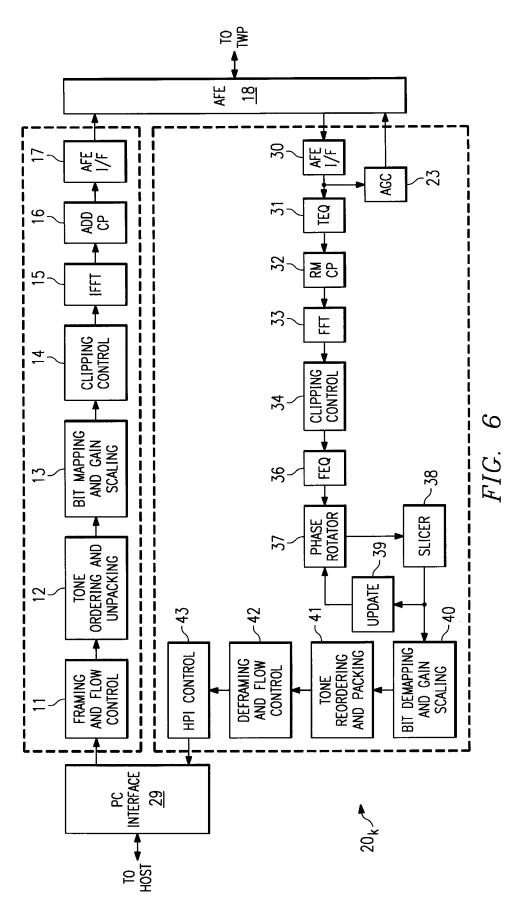
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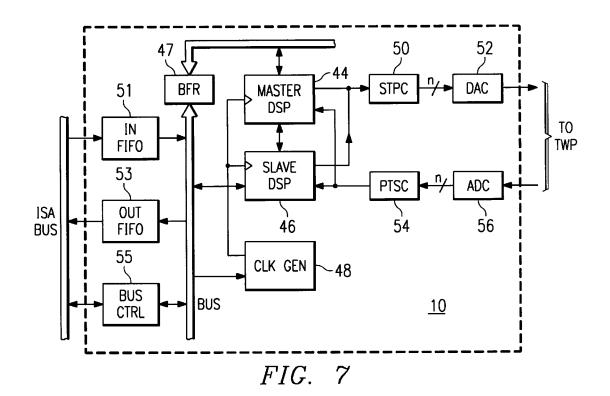
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CENTRAL OFFICE MODEM 20k **REMOTE MODEM 10** INIT_REQ INIT ACK 60R-ACTIVATION AND ACTIVATION AND -60C ACKNOWLEDGEMENT ACKNOWLEDGEMENT ACK TRANSCEIVER -62C 62R-TRANSCEIVER TRAINING TRAINING CHANNEL CHANNEL -64C 64R-ANALYSIS ANALYSIS EXCHANGE EXCHANGE -66C 66R-TO COMMUNICATION OF DATA FIG. 8

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