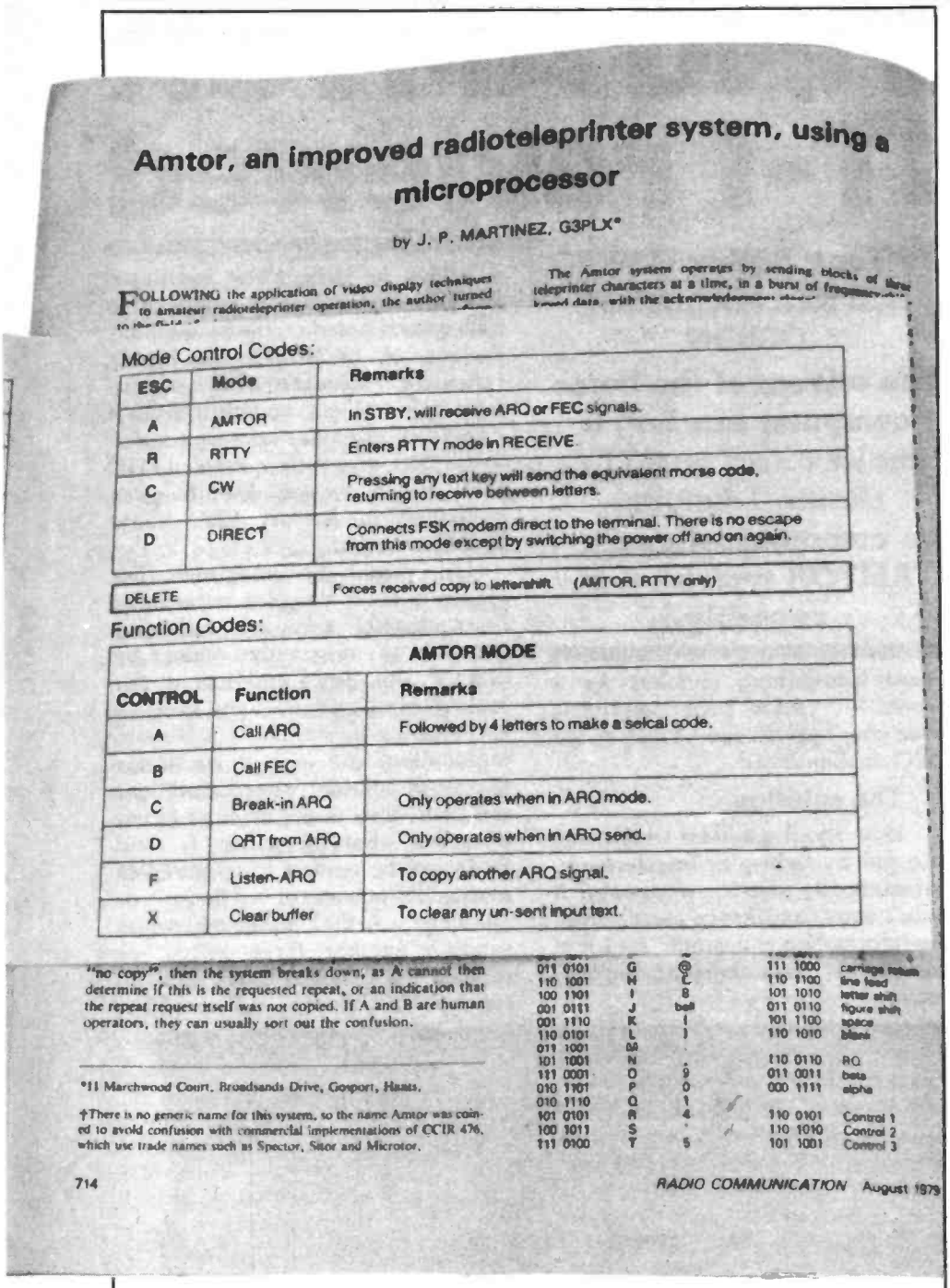

Amtor, an improved radioteleprinter system, using a microprocessor

by J. P. MARTINEZ, G3PLX*

FOLLOWING the application of video display techniques to amateur radioteleprinter operation, the author turned

The Amtor system operates by sending blocks of three teleprinter characters at a time, in a burst of frequency-

Mode Control Codes:

ESC	Mode	Remarks
A	AMTOR	In STBY, will receive ARQ or FEC signals.
R	RTTY	Enters RTTY mode in RECEIVE.
C	CW	Pressing any text key will send the equivalent morse code, returning to receive between letters.
D	DIRECT	Connects FSK modem direct to the terminal. There is no escape from this mode except by switching the power off and on again.
DELETE		Forces received copy to lettershift. (AMTOR, RTTY only)

Function Codes:

AMTOR MODE		
CONTROL	Function	Remarks
A	Call ARQ	Followed by 4 letters to make a selcal code.
B	Call FEC	
C	Break-in ARQ	Only operates when in ARQ mode.
D	QRT from ARQ	Only operates when in ARQ send.
F	Listen-ARQ	To copy another ARQ signal.
X	Clear buffer	To clear any un-sent input text.

"no copy", then the system breaks down, as A cannot then determine if this is the requested repeat, or an indication that the repeat request itself was not copied. If A and B are human operators, they can usually sort out the confusion.

*11 Marchwood Court, Broadsands Drive, Gosport, Hants.

†There is no generic name for this system, so the name Amtor was coined to avoid confusion with commercial implementations of CCIR 476, which use trade names such as Spector, Sitor and Microtor.

011 0101	G	@	111 1000 carriage return
110 1001	H	£	110 1100 line feed
100 1101	I	8	101 1010 letter shift
001 0111	J	bell	011 0110 figure shift
001 1110	K	(	101 1100 space
110 0101	L	)	110 1010 blank
011 1001	M		
101 1001	N	,	110 0110 RQ
111 0001	O	9	011 0011 beta
010 1101	P	0	000 1111 alpha
010 1110	Q	1	
101 0101	R	4	110 0101 Control 1
100 1011	S	'	110 1010 Control 2
111 0100	T	5	101 1001 Control 3

AMTOR modes — and the original *RadCom* article

arises if the request for a repeat is garbled or not copied as A doesn't then know whether he is being told "no copy" or has just missed the actual repeat. With human operators such problems can ususally be sorted out.

AMTOR works by sending blocks of three standard teleprinter characters at a time, as FSK data, with acknowledgement signals coming back from the receive station in the same manner. The miscopy problem is overcome by using two coded signals called Control 1 and Control 2. When the receiving station is copying OK, he acknowledges with Control 1 and Control 2 signals sent alternately after each block, and if an error is detected, he repeats the same control signal as last time. Thus if A sends a repeat request, B does just that (or if B receives an error the same happens) until a perfect copy has been made.

With voice communication, errors are recogniseable by human operators, except those which the human ear can misinterpret, such as the classic of "send reinforcements, we are going to advance" becoming "send three and fourpence we are going to a dance"!

In an RTTY system, the possible number of errors is limited by the 32 characters used, these being obtained by using all the combinations of the five elements of the Baudot Code. With AMTOR, seven data elements are used, giving a possible 128 combinations, so that if only 32 are valid, reception of any of the others must be due to an error. The codes used out of these 128 combinations were specially selected to minimise errors, by choosing only those which had three '0" and four '1' elements, making error detection by the MPU reasonably easy.

Combinations

There are in fact 35 possible combinations using this rule — of the remaining three, one is used as a repeat request character, known as the "RQ" character, one is an idle character, known as "beta", and the third, "alpha", is also idle but also has a special control function.

Once A has finished his message, the QSO has to reverse direction, but such that both stations do not try and send at the same time. With AMTOR, when B wants to start a message, he stops sending Controls 1 & 2, and instead sends Control 3. When A receives this he sends a block consisting of beta, alpha, beta. When this is copied by B, B changes to transmitting blocks, and receiving control codes. The timing of all this is quite critical, and readers are referred to the original article (*Radcom*, August 1979) if they are interested. Also, because of the small time delay between sending and transmitting, there is a practical limit on the distances that can be covered with AMTOR, depending on your exact RX/TX and its changeover delay.

Because of the error detection and correction used, the system is much more reliable than ordinary RTTY, in fact very much more reliable.

Synchronisation

Obviously this is required to maintain the accurate timing needed, and is achieved using a series of sync blocks sent by the master (station A) until the slave (station B) has