81/27

EISCAT
TECHNICAL
NOTE

Standard Subroutines and Programs for EISCAT Digital Correlator

by
Terrance Ho

KIRUNA
Sweden

STANDARD SUBROUTINES AND PROGRAMS FOR EISCAT DIGITAL CORRELATOR

by

TERRANCE HO
MAX PLANCK INSTITUT
POSTFACH 20
D-3411 KATLENBURG-LINDAU 3
W. GERMANY

EISCAT Technical Note 81/27
Printed in Sweden
EISCAT Scientific Association
Kiruna, April 1982
ISSN 0349-2710

TABLE OF CONTENTS

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE SUBROUTINE (VERSION 1)
FILE-NAME (NORD 10): PROGØ:DATA
PROGRAM DESCRIPTION:

DATA CHANNEL 1 ZERO LAG ESTIMATION $K_r = \sum_{i=0}^{N-1} (X^2_{i+(N+D-1)(r-1)} + Y^2_{i+(N+D-1)(r-1)})$

DATA CHANNEL 2 MEAN VALUE ESTIMATION $M_r = \sum_{i=0}^{N-1} (X_{i+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)})$

WHERE N=NO. OF SAMPLES IN RANGECELL
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND $\leq$0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

MINIMUM NO. OF SAMPLES IN RANGEDATA: 1

NOTES

1. The formulae above are given with respect to the way in which the X, Y samples are read from the buffer memory.
2. The Q registers of the APB, APM processors must be defined with the start addresses of the buffer, result memories in the main program.
3. The LCR1 register must be reloaded with the APBRS(15) register and the LCR2 register must be reloaded with the APBRS(14) register in the main program.

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 - 6

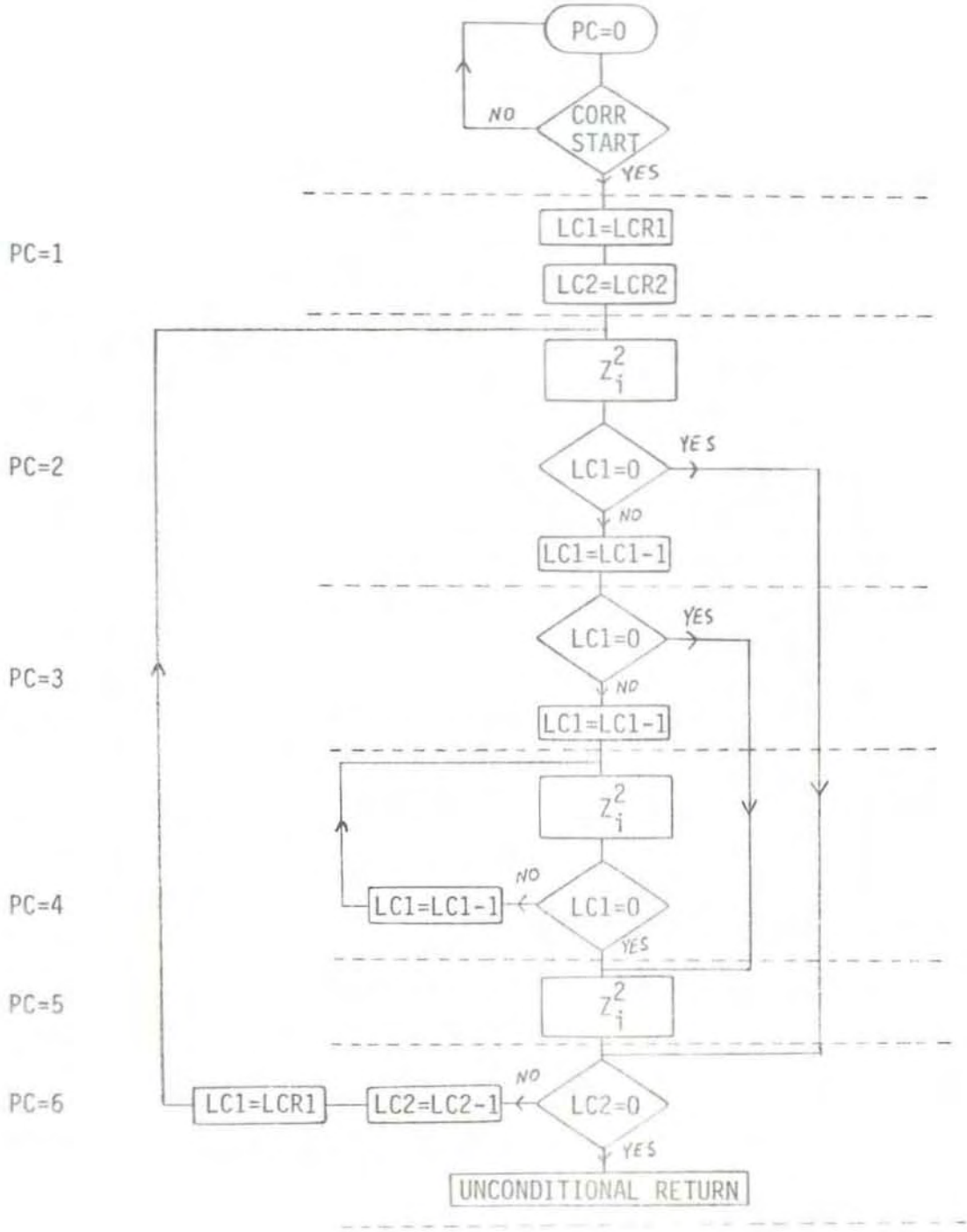
MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE SUBROUTINE (VERSION 1)
FILE-NAME (NORD 10): PROGØ:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF SUBROUTINE
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE
APB RS(13)	16,13	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS)
APB RS(12)	16,12	SAMPLE INCREMENT (NORMALLY=1)
APM RS(15)	17,15	INCREMENT (=1)

POWER PROFILE SUBROUTINE (VERSION 1)



MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE SUBROUTINE (VERSION 1)
FILE-NAME (NORD 10): PROGØ:DATA
PROGRAM DESCRIPTION:

	APB PROCESSOR		APM PROCESSOR	
PC=1	Q=F	F→Q-RS(13)	Q=F	F→Q-RS(15)
PC=2	Q=F	F→RS(13)+Q	Q=F	F→RS(15)+Q
PC=3		F→Q	DO NOTHING	
PC=4	Q=F	F→RS(12)+Q	DO NOTHING	
PC=5	Q=F	F→RS(12)+Q		F→Q
PC=6	DO NOTHING		DO NOTHING	

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : POWER PROFILE SUBROUTINE (VERSION 1)

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	2	0	3	0	0	0
2	57	6	4	6	1	0	0	0	0	0
3	57	6	4	5	1	0	0	0	0	0
4	57	4	6	4	1	0	0	0	0	0
5	56	0	4	0	0	0	0	0	0	0
6	58	1	6	2	2	0	1	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	0	1	0	13	0	0
2	0	0	0	13	0	0
3	2	0	1	0	0	0
4	0	0	0	12	0	0
5	0	0	0	12	0	0
6	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	0	1	0	15	0
2	0	0	0	15	0
3	7	5	1	0	0
4	7	5	1	0	0
5	2	0	1	0	0
6	7	5	1	0	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	1	1	4	0	4	1	3	3	3	3	9	9
3	0	0	0	0	0	0	0	0	3	3	3	3	6	6
4	0	0	1	1	4	0	4	1	3	3	3	3	9	9
5	0	0	1	1	4	0	4	1	3	3	3	3	9	9
6	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	1	0	0	0
2	1	1	1	0	0	0	0
3	1	0	0	0	0	0	0
4	1	0	0	0	0	0	0
5	1	1	0	0	0	0	0
6	1	0	0	0	0	0	0

I/O INSTRUCTIONS DEFINED

MEM-LOC.	SETF	CLEARF	SELECT	BUF.ADDR.	STROBE	I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0		0		0	0
1	0	0	0		0		0	0
2	0	0	0		0		0	0
3	0	0	0		0		0	0
4	0	0	0		0		0	0
5	0	0	0		0		0	0
6	0	0	0		0		0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT	CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0		0	0	0
1	0	0		0	0	0
2	0	0		0	0	0
3	0	0		0	0	0
4	0	0		0	0	0
5	0	0		0	0	0
6	0	0		0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE SUBROUTINE (VERSION 2)
FILE-NAME (NORD 10): PROG1:DATA
PROGRAM DESCRIPTION:

DATA CHANNEL 1 ZERO LAG ESTIMATION $K_r = \sum_{i=0}^{N-1} (X^2_{i+(N+D-1)(r-1)} + Y^2_{i+(N+D-1)(r-1)})$

DATA CHANNEL 2 MEAN VALUE ESTIMATION $M_r = \sum_{i=0}^{N-1} (X_{i+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)})$

DATA CHANNEL 1 MEAN VALUE X ESTIMATION $M_{X,r} = \sum_{i=0}^{N-1} X_{i+(N+D-1)(r-1)}$

DATA CHANNEL 2 MEAN VALUE Y ESTIMATION $M_{Y,r} = \sum_{i=0}^{N-1} Y_{i+(N+D-1)(r-1)}$

WHERE N=NO. OF SAMPLES IN RANGECELL
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND ≤0 FOR OVERLAPPING)
r=1,2,....,M RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

MINIMUM NO. OF SAMPLES IN RANGEDATA: 1

NOTES

1. The formulae above are given with respect to the way in which the X, Y samples are read from the buffer memory.
2. The Q registers of the APB, APM processors must be defined with the start addresses of the buffer, result memories in the main program.
3. The LCR1 register must be reloaded with the APBRS(15) register and the LCR2 register must be reloaded with the APBRS(14) register in the main program.
4. In a particular rangecell the zero lag estimation K_r and M_r are computed first and the mean value estimation $M_{X,r}$ and $M_{Y,r}$ second.

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 - 6

MICRO-PROGRAM FOR DIGITAL CORRELATOR

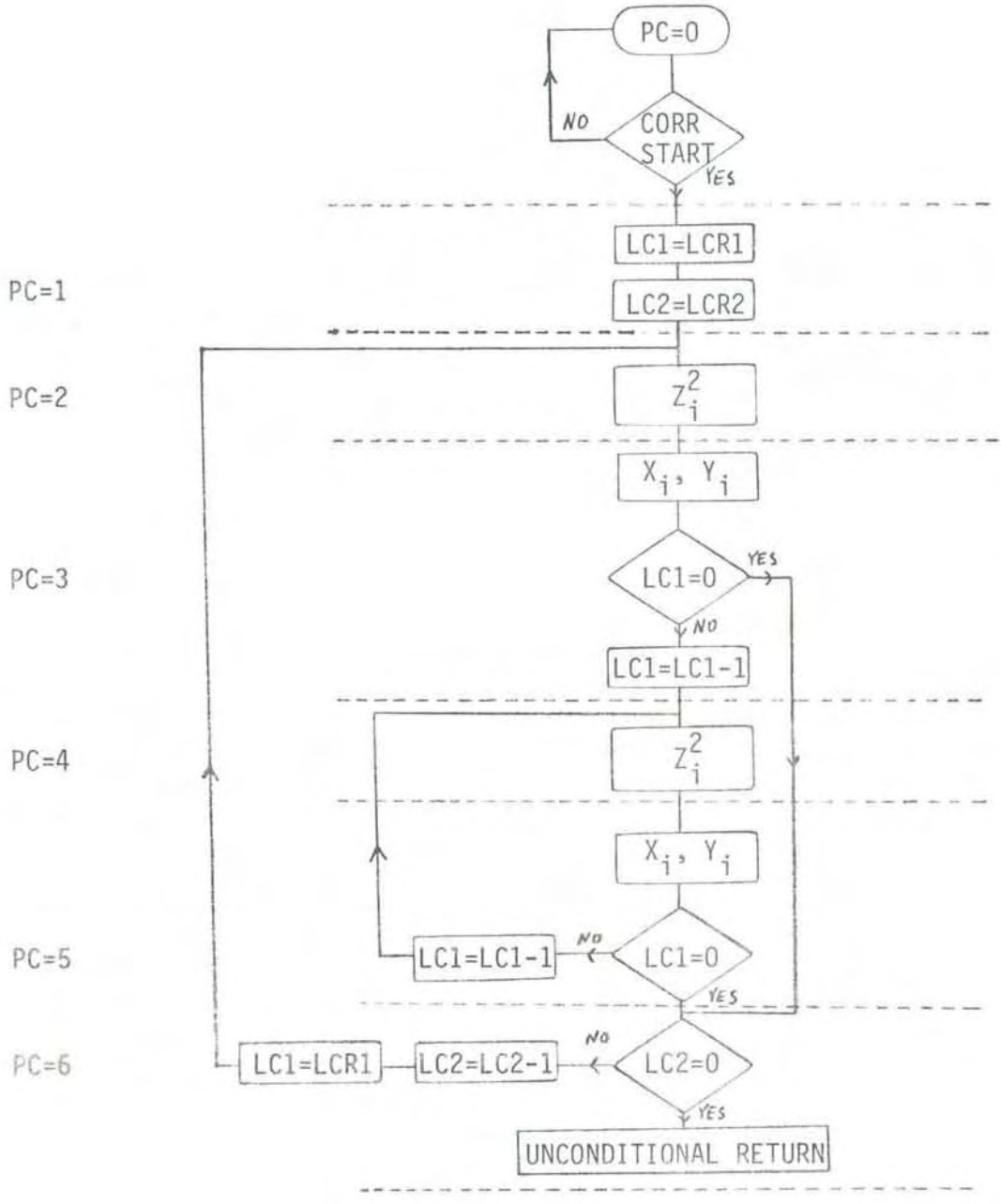
AUTOR: TERRANCE HO

DATE: 6/8/80

PROGRAM NAME: POWER PROFILE SUBROUTINE (VERSION 2)
FILE-NAME (NORD 10): PROG1:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF SUBROUTINE
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE
APB RS(13)	16,13	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS)
APB RS(12)	16,12	SAMPLE INCREMENT (NORMALLY=1)
APM RS(15)	17,15	INCREMENT (=1)

POWER PROFILE SUBROUTINE (VERSION 2)



MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE SUBROUTINE (VERSION 2)
FILE-NAME (NORD 10): PROG1:DATA
PROGRAM DESCRIPTION:

	APB PROCESSOR		APM PROCESSOR	
PC=1	Q=F	F→Q-RS(13)	Q=F	F→Q-RS(15)
PC=2	Q=F	F→RS(13)+Q	Q=F	F→RS(15)+Q
PC=3		F→Q		F→RS(15)+Q
PC=4	Q=F	F→RS(12)+Q		F→Q
PC=5		F→Q		F→RS(15)+Q
PC=6	DO NOTHING		Q=F	F→RS(15)+Q

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : POWER PROFILE SUBROUTINE (VERSION 2)

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	2	0	3	0	0	0
2	56	0	4	0	0	0	0	0	0	0
3	57	6	4	6	1	0	0	0	0	0
4	56	0	4	0	0	0	0	0	0	0
5	57	4	6	4	1	0	0	0	0	0
6	58	1	6	2	2	0	1	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	0	1	0	13	0	0
2	0	0	0	13	0	0
3	2	0	1	0	0	0
4	0	0	0	12	0	0
5	2	0	1	0	0	0
6	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	0	1	0	15	0
2	0	0	0	15	0
3	0	0	1	15	0
4	2	0	1	0	0
5	0	0	1	15	0
6	0	0	0	15	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	1	1	4	0	4	1	3	3	3	3	9	9
3	4	0	4	0	4	1	4	1	3	3	3	3	15	15
4	0	0	1	1	4	0	4	1	3	3	3	3	9	9
5	4	0	4	0	4	1	4	1	3	3	3	3	15	15
6	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	1	0	0	0
2	1	1	1	1	0	0	0
3	1	1	1	0	0	0	0
4	1	1	1	0	1	0	0
5	1	1	1	0	0	0	0
6	1	0	0	0	0	0	0

I/O INSTRUCTIONS DEFINED

MEM-LOC.	SETF	CLEARF	SELECT	BUF.ADDR.	STROBE	I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0		0		0	0
1	0	0	0		0		0	0
2	0	0	0		0		0	0
3	0	0	0		0		0	0
4	0	0	0		0		0	0
5	0	0	0		0		0	0
6	0	0	0		0		0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT	CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0		0
1	0	0	0	0		0
2	0	0	0	0		0
3	0	0	0	0		0
4	0	0	0	0		0
5	0	0	0	0		0
6	0	0	0	0		0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: SINGLE PULSE SUBROUTINE (NO. OF LAGS .EQ. NO. OF SAMPLES)
FILE-NAME (NORD 10): PROG2:DATA
PROGRAM DESCRIPTION:

DATA CHANNEL 1

$$Re\{K_{L,r}\} = \sum_{i=0}^{N-L-1} (X_{i+(N+D-1)(r-1)} X_{i+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

DATA CHANNEL 2

$$Im\{K_{L,r}\} = \sum_{i=0}^{N-L-1} (X_{i+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=0,1,2,...,N-1
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND $\leq$0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

MINIMUM NO. OF SAMPLES IN RANGEDATA: 1

NOTES

1. The formulae above are given with respect to the way in which the X, Y samples are read from the buffer memory.
2. The Q registers of the APB, APM processors must be defined with the start addresses of the buffer, result memories in the main program.
3. The LCR1 register must be reloaded with the APBRS(15) register and the LCR2 register must be reloaded with the APBRS(14) register in the main program.

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 - 6

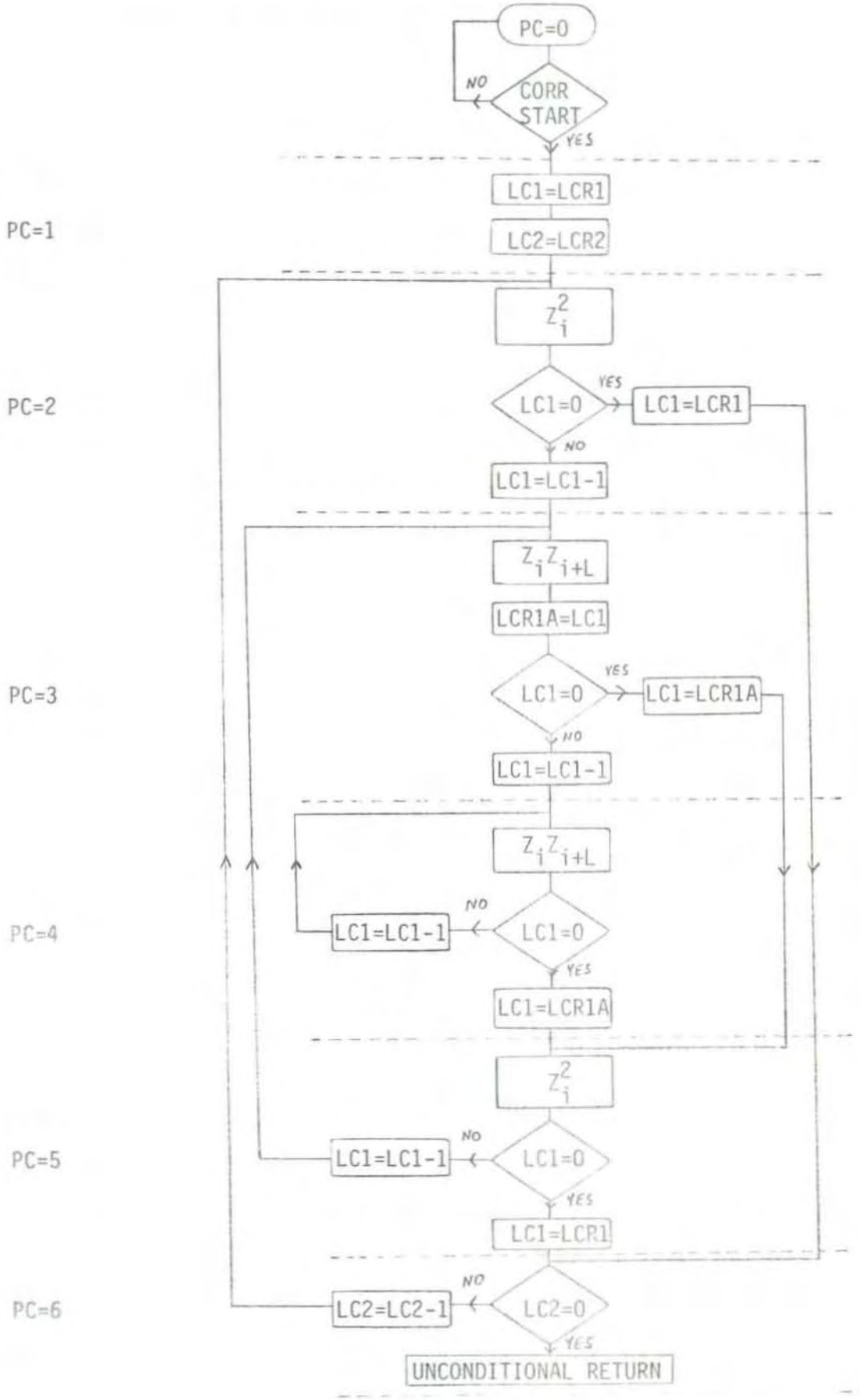
MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: SINGLE PULSE SUBROUTINE (NO. OF LAGS .EQ. NO. OF SAMPLES)
FILE-NAME (NORD 10): PROG2:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF SUBROUTINE
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL
APB RS(14)	16,14	NO. OF RANGECELL-1 FOR TIME AVERAGE
APB RS(13)	16,13	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS)
APB RS(12)	16,12	SAMPLE INCREMENT (NORMALLY=1)
APB RS(11)	16,11	TEMPORARY STORAGE
APM RS(15)	17,15	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED)
APM RS(14)	17,14	INCREMENT (=1)
APM RS(13)	17,13	TEMPORARY STORAGE

SINGLE PULSE SUBROUTINE (NO. OF LAGS .EQ. NO. OF SAMPLES)



MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: SINGLE PULSE SUBROUTINE (NO. OF LAGS .EQ. NO. OF SAMPLES)
FILE-NAME (NORD 10): PROG2:DATA
PROGRAM DESCRIPTION:

	APB PROCESSOR			APM PROCESSOR		
PC=1		Q=F	F→Q-RS(13)		Q=F	F→Q-RS(15)
PC=2		Q=F	F→RS(13)+Q		Q=F	F→RS(15)+Q
PC=3	RS(11)=F		F→RS(12)+Q	RS(13)=F		F→RS(14)+Q
PC=4	RS(11)=F		F→RS(12)+RS(11)	RS(13)=F		F→RS(14)+RS(13)
PC=5		Q=F	F→RS(12)+Q			F→Q
PC=6	DO NOTHING			DO NOTHING		

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : SINGLE PULSE SUBROUTINE (NO. OF LAGS .EQ. NO. OF SAMPLES)

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	2	0	3	0	0	0
2	57	6	4	6	6	0	0	0	0	0
3	57	6	4	5	7	1	0	0	0	0
4	57	4	6	4	7	0	0	0	0	0
5	57	4	6	3	6	0	0	0	0	0
6	58	1	6	2	0	0	1	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	0	1	0	13	0	0
2	0	0	0	13	0	0
3	0	0	3	12	11	0
4	1	0	3	12	11	0
5	0	0	0	12	0	0
6	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	0	1	0	15	0
2	0	0	0	15	0
3	0	0	3	14	13
4	1	0	3	14	13
5	2	0	1	0	0
6	7	5	1	0	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	1	1	1	0	0	1	3	3	3	3	9	6
3	0	0	1	1	1	0	0	1	2	2	2	2	9	6
4	0	0	1	1	1	0	0	1	2	2	2	2	9	6
5	0	0	1	1	1	0	0	1	3	3	3	3	9	6
6	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE	I/O WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	1	1	1	1	0	0	0
3	1	1	1	0	0	0	0
4	1	1	1	0	0	0	0
5	1	1	1	0	1	0	0
6	1	0	0	0	0	0	0

I/O INSTRUCTIONS DEFINED

MEM-LOC.	SETF	CLEARF	SELECT	BUF.ADDR.	STROBE	I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0	0	0		0	0
1	0	0	0	0	0		0	0
2	0	0	0	0	0		0	0
3	0	0	0	0	0		0	0
4	0	0	0	0	0		0	0
5	0	0	0	0	0		0	0
6	0	0	0	0	0		0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: SINGLE PULSE SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES)
FILE-NAME (NORD 10): PROG3:DATA
PROGRAM DESCRIPTION:

DATA CHANNEL 1

$$Re\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+(N+D-1)(r-1)} X_{i+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)}\right)$$

DATA CHANNEL 2

$$Im\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)}\right)$$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=0,1,2,...,P P≤N-1
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND ≤0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
MINIMUM NO. OF LAGS IN RANGEDATA: 2

NOTES

1. The formulae above are given with respect to the way in which the X, Y samples are read from the buffer memory.
2. The Q registers of the APB, APM processors must be defined with the start addresses of the buffer, result memories in the main program.
3. The LCR1 register must be reloaded with the APBRS(15) register, the LCR2 register must be reloaded with the APBRS(14) register and the LCR3 register must be reloaded with the the APBRS(13) register in the main program.

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 - 7

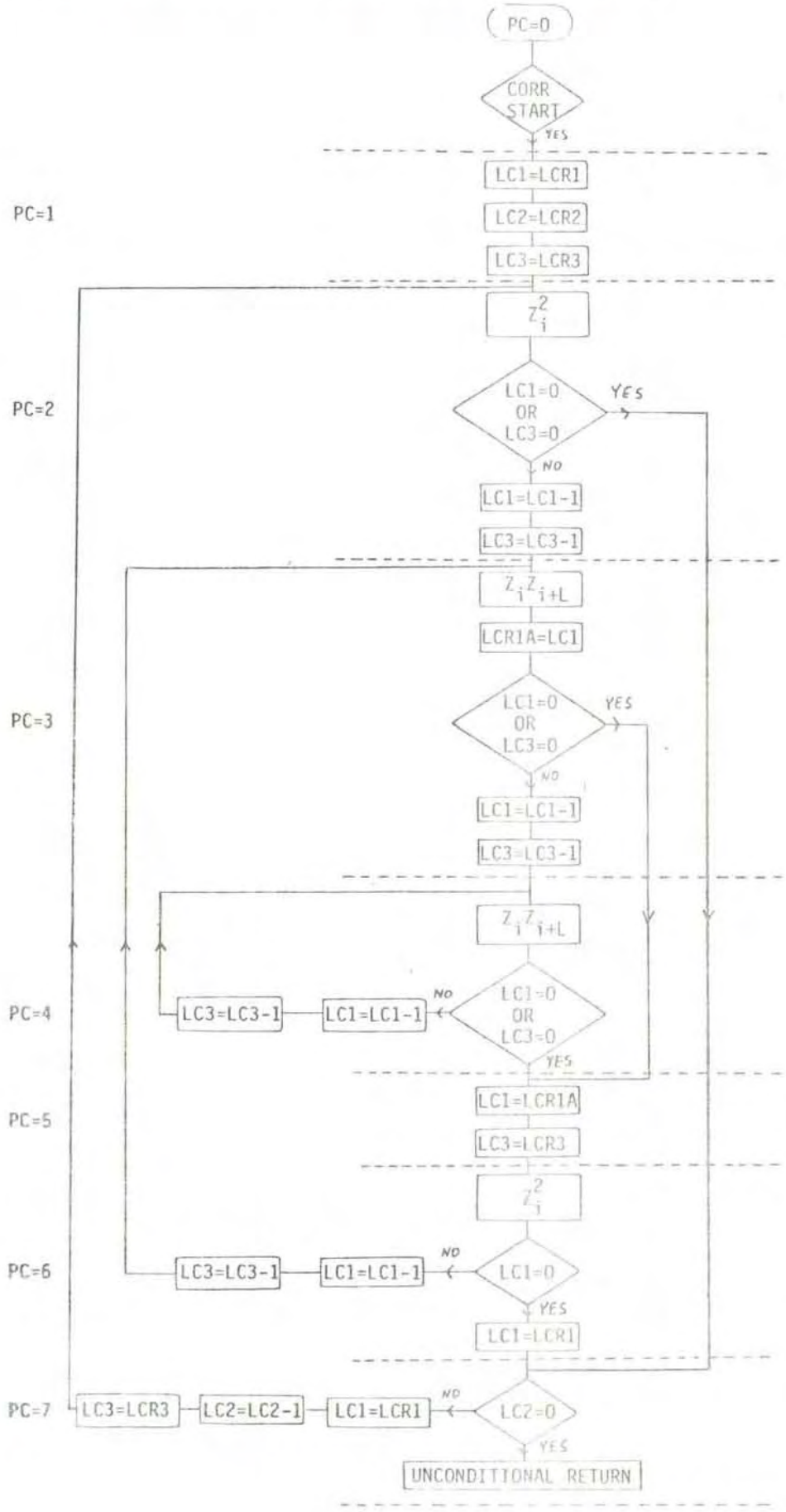
MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: SINGLE PULSE SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES)
FILE-NAME (NORD 10): PROG3:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF SUBROUTINE
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE
APB RS(13)	16,13	NO. OF LAGS-1 IN RANGECELL
APB RS(12)	16,12	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS)
APB RS(11)	16,11	SAMPLE INCREMENT (NORMALLY=1)
APB RS(10)	16,10	TEMPORARY STORAGE
APM RS(15)	17,15	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED)
APM RS(14)	17,14	INCREMENT (=1)
APM RS(13)	17,13	TEMPORARY STORAGE

SINGLE PULSE SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES)



MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: SINGLE PULSE SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES)
FILE-NAME (NORD 10): PROG3:DATA
PROGRAM DESCRIPTION:

	APB PROCESSOR		APM PROCESSOR	
PC=1	Q=F	F→Q-RS(12)	Q=F	F→Q-RS(15)
PC=2	Q=F	F→RS(12)+Q	Q=F	F→RS(15)+Q
PC=3	RS(10)=F	F→RS(11)+Q	RS(13)=F	F→RS(14)+Q
PC=4	RS(10)=F	F→RS(11)+RS(10)	RS(13)=F	F→RS(14)+RS(13)
PC=5	DO NOTHING		DO NOTHING	
PC=6	Q=F	F→RS(11)+Q		F→Q
PC=7	DO NOTHING		DO NOTHING	

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : SINGLE PULSE SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES)

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	2	0	3	2	0	0
2	61	6	4	7	1	0	0	1	0	0
3	61	6	4	5	1	1	0	1	0	0
4	61	4	6	4	1	0	0	1	0	0
5	56	0	4	0	3	0	0	2	0	0
6	57	4	6	3	6	0	0	1	0	0
7	58	1	6	2	2	0	1	2	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	0	1	0	12	0	0
2	0	0	0	12	0	0
3	0	0	3	11	10	0
4	1	0	3	11	10	0
5	7	5	1	0	0	0
6	0	0	0	11	0	0
7	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	0	1	0	15	0
2	0	0	0	15	0
3	0	0	3	14	13
4	1	0	3	14	13
5	7	5	1	0	0
6	2	0	1	0	0
7	7	5	1	0	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	1	1	1	0	0	1	3	3	3	3	9	6
3	0	0	1	1	1	0	0	1	2	2	2	2	9	6
4	0	0	1	1	1	0	0	1	2	2	2	2	9	6
5	0	0	0	0	0	0	0	0	0	0	0	0	15	15
6	0	0	1	1	1	0	0	1	3	3	3	3	9	6
7	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	1	1	1	1	0	0	0
3	1	1	1	0	0	0	0
4	1	1	1	0	0	0	0
5	1	0	0	0	0	0	0
6	1	1	1	0	1	0	0
7	1	0	0	0	0	0	0

I/O INSTRUCTIONS DEFINED

MEM-LOC.	SETF	CLEARF	SELECT BUF.ADDR.	STROBE I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: REGIS GRAS DATE: 6/8/80

PROGRAM NAME: SINGLE PULSE SUBROUTINE (NO. OF LAGS .EQ. NO. SAMPLES) (VER.2)
FILE-NAME (NORD 10): PROG9:DATA
PROGRAM DESCRIPTION:

DATA CHANNEL 1 MEAN VALUE X^2 ESTIMATION $M_{XX,r} = \sum_{i=0}^{N-1} X^2_{i+(N+D-1)(r-1)}$

DATA CHANNEL 2 MEAN VALUE Y^2 ESTIMATION $M_{YY,r} = \sum_{i=0}^{N-1} Y^2_{i+(N+D-1)(r-1)}$

DATA CHANNEL 1

$$Re\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} (X_{i+(N+D-1)(r-1)} X_{i+L+(N+D-1)(r-1)} + Y_{i+(n+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

DATA CHANNEL 2

$$Im\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} (X_{i+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

FOR ZERO LAG (L=0) DATA CHANNEL 2

MEAN VALUE XY ESTIMATION $M_{XY,r} = \sum_{i=0}^{N-1} X_{i+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)}$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=0,1,2,...,N-1
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND ⩽0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

MINIMUM NO. OF SAMPLES IN RANGEDATA: 1

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 - 8

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: REGIS GRAS DATE: 6/8/80

PROGRAM NAME: SINGLE PULSE SUBROUTINE (NO. OF LAGS .EQ. NO. SAMPLES) (VER.2)
FILE-NAME (NORD 10): PROG9:DATA
PROGRAM DESCRIPTION:

NOTES

1. The formulae above are given with respect to the way in which the X, Y samples are read from the buffer memory.
2. The Q registers of the APB, APM processors must be defined with the start addresses of the buffer, result memories in the main program.
3. The LCR1 register must be reloaded with the APBRS(15) register and the LCR2 register must be reloaded with the APBRS(14) register in the main program.

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

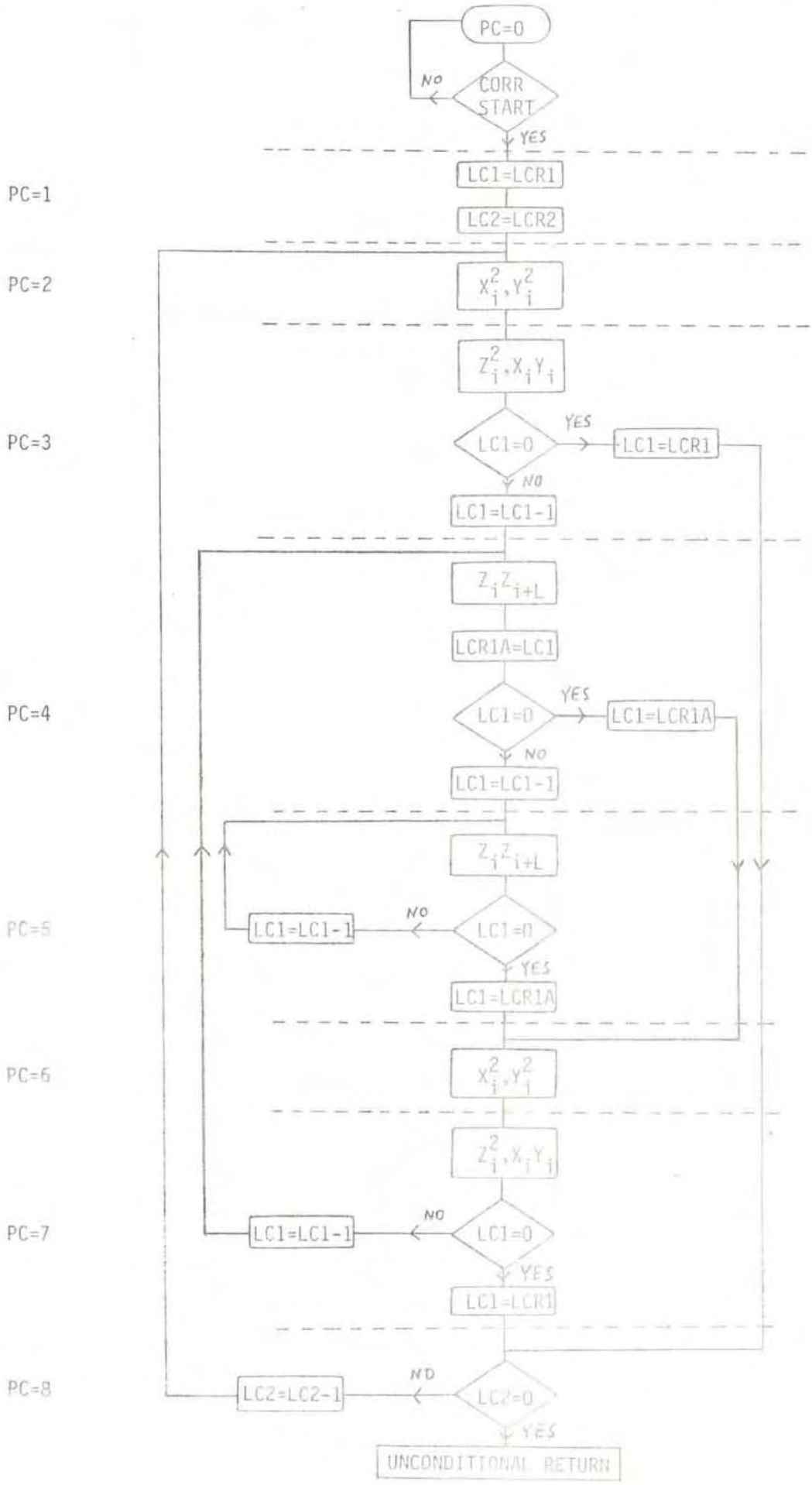
AUTOR: REGIS GRAS

DATE: 6/8/80

PROGRAM NAME: SINGLE PULSE SUBROUTINE (NO. OF LAGS .EQ. NO. SAMPLES) (VER.2)
FILE-NAME (NORD 10): PROG9:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF SUBROUTINE
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE
APB RS(13)	16,13	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS)
APB RS(12)	16,12	SAMPLE INCREMENT (NORMALLY=1)
APB RS(11)	16,11	TEMPORARY STORAGE
APM RS(15)	17,15	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED)
APM RS(14)	17,14	INCREMENT (=1)
APM RS(13)	17,13	TEMPORARY STORAGE

SINGLE PULSE SUBROUTINE (NO. OF LAGS .EQ. NO. OF SAMPLES) (VER.2)



MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: REGIS GRAS DATE: 6/8/80

PROGRAM NAME: SINGLE PULSE SUBROUTINE (NO. OF LAGS .EQ. NO. SAMPLES) (VER.2)
FILE-NAME (NORD 10): PROG9:DATA
PROGRAM DESCRIPTION:

	APB PROCESSOR			APM PROCESSOR		
PC=1		Q=F	F→Q-RS(13)		Q=F	F→Q-RS(15)
PC=2		Q=F	F→RS(13)+Q		Q=F	F→RS(15)+Q
PC=3			F→Q		Q=F	F→RS(14)+Q
PC=4	RS(11)=F		F→RS(12)+Q	RS(13)=F		F→RS(14)+Q
PC=5	RS(11)=F		F→RS(12)+RS(11)	RS(13)=F		F→RS(14)+RS(13)
PC=6		Q=F	F→RS(12)+Q		Q=F	F→Q-RS(14)
PC=7			F→Q		Q=F	F→RS(14)+Q
PC=8	DO NOTHING			DO NOTHING		

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : SINGLE PULSE SUBROUTINE (NO. OF LAGS .EQ. NO. OF SAMPLES) (VER.2)

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	2	0	3	0	0	0
2	56	0	4	0	0	0	0	0	0	0
3	57	6	4	6	6	0	0	0	0	0
4	57	6	4	6	7	1	0	0	0	0
5	57	4	6	5	7	0	0	0	0	0
6	56	0	4	0	0	0	0	0	0	0
7	57	4	6	4	6	0	0	0	0	0
8	58	1	6	2	0	0	1	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	0	1	0	13	0	0
2	0	0	0	13	0	0
3	2	0	1	0	0	0
4	0	0	3	12	11	0
5	1	0	3	12	11	0
6	0	0	0	12	0	0
7	2	0	1	0	0	0
8	7	5	1	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	0	1	0	15	0
2	0	0	0	15	0
3	0	0	0	14	0
4	0	0	3	14	13
5	1	0	3	14	13
6	0	1	0	14	0
7	0	0	0	14	0
8	7	5	1	0	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SH1	SH2	SH3	SH4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	1	1	0	0	1	1	3	3	3	3	15	5
3	0	0	1	1	1	0	0	1	3	3	3	3	9	15
4	0	0	1	1	1	0	0	1	2	2	2	2	9	6
5	0	0	1	1	1	0	0	1	2	2	2	2	9	6
6	0	0	1	1	0	0	1	1	3	3	3	3	15	5
7	0	0	1	1	1	0	0	1	3	3	3	3	9	15
8	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	1	1	1	1	0	0	0
3	1	1	1	0	0	0	0
4	1	1	1	0	0	0	0
5	1	1	1	0	0	0	0
6	1	1	1	0	1	0	0
7	1	1	1	0	0	0	0
8	1	0	0	0	0	0	0

I/O INSTRUCTIONS DEFINED

MEM-LOC.	SETF	CLEARF	SELECT	BUF.ADDR.	STROBE	I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0		0	0	0	0
1	0	0	0		0	0	0	0
2	0	0	0		0	0	0	0
3	0	0	0		0	0	0	0
4	0	0	0		0	0	0	0
5	0	0	0		0	0	0	0
6	0	0	0		0	0	0	0
7	0	0	0		0	0	0	0
8	0	0	0		0	0	0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	1	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: MULTI PULSE SUBROUTINE
FILE-NAME (NORD 10): PROG4:DATA
PROGRAM DESCRIPTION:

DATA CHANNEL 1 $\mathrm{Re}\{K_{L,r}\} = X_{S+r-1}X_{S+L+r-1} + Y_{S+r-1}Y_{S+L+r-1}$

DATA CHANNEL 2 $\mathrm{Im}\{K_{L,r}\} = X_{S+L+r-1}Y_{S+r-1} - X_{S+r-1}Y_{S+L+r-1}$

LET J_0=POSITION OF 1st PULSE
J_1=SAMPLE DIFFERENCE BETWEEN 1st AND 2nd PULSE
:
J_{N-1}=SAMPLE DIFFERENCE BETWEEN 1st AND Nth PULSE

WHERE $S=J_0,J_1,J_2,\ldots,J_{N-2}$

$L=J_1-S,J_2-S,\ldots,J_{N-1}-S$ WITH THE RESTRICTION $L>0$

$r=1,2,\ldots,M$ RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

MINIMUM NO. OF ELEMENT PULSES IN PULSE GROUP: 2
MAXIMUM NO. OF ELEMENT PULSES IN PULSE GROUP: 13

NOTES

1. The formulae above are given with respect to the way in which the X, Y samples are read from the buffer memory.
2. The Q registers of the APB, APM processors must be defined with the start addresses of the buffer, result memories in the main program.
3. The LCR1 register must be reloaded with the APBRS(15) register and the LCR2 register must be reloaded with the APBRS(14) register in the main program.
4. The zero lag is not computed in this algorithm, therefore to calculate the number of lags computed use the formula: $N(N-1)/2$ where N is the number of element pulses in the pulse group.

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 - 6

MICRO-PROGRAM FOR DIGITAL CORRELATOR

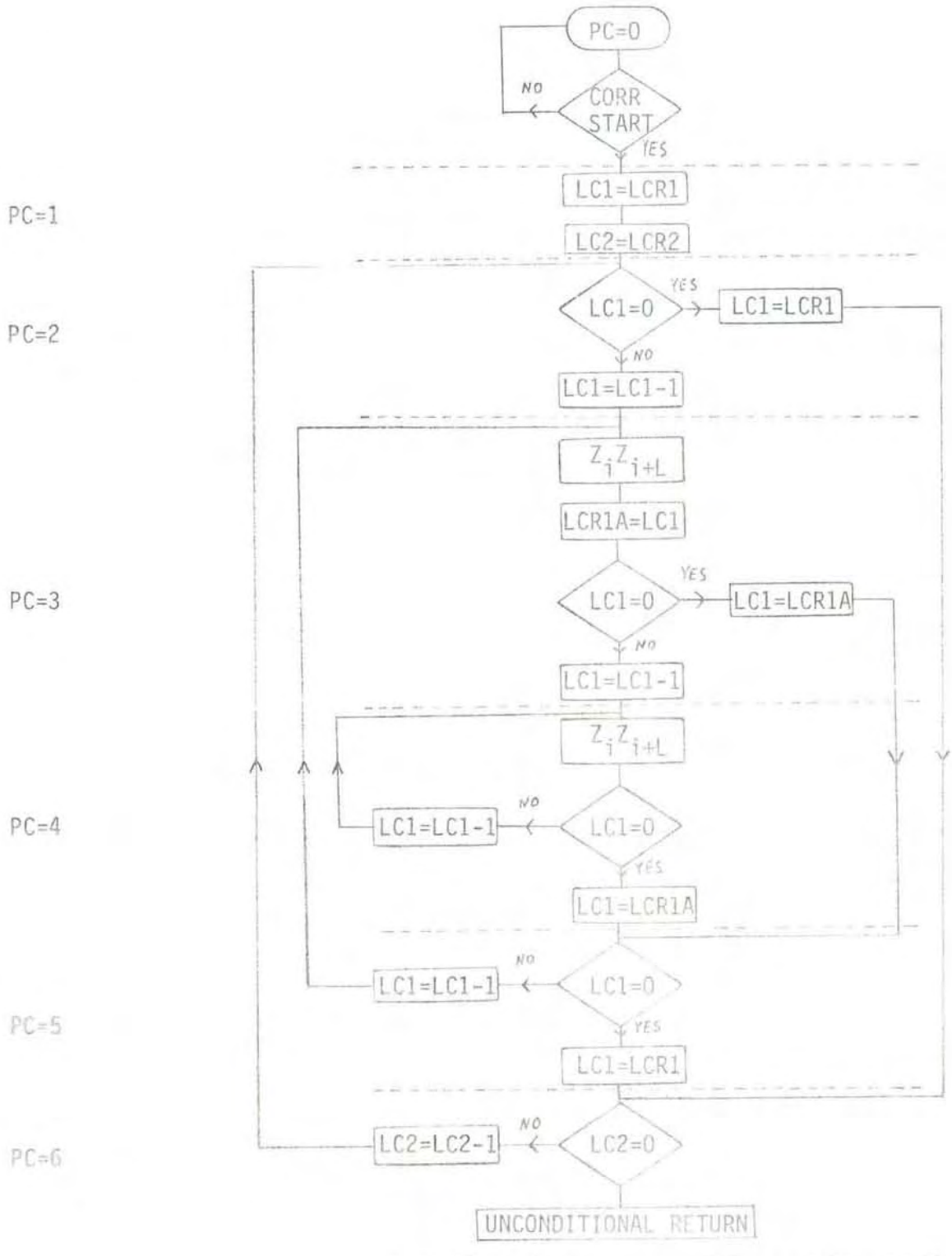
AUTOR: TERRANCE HO

DATE: 6/8/80

PROGRAM NAME: MULTI PULSE SUBROUTINE
FILE-NAME (NORD 10): PROG4:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF SUBROUTINE
APB RS(15)	16,15	NO. OF PULSES-1 IN RANGECELL
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE
APB RS(13)	16,13	RANGECELL INCREMENT (NORMALLY=1)
APB RS(12)	16,12	TEMPORARY STORAGE
⋮	⋮	⋮
APB RS(1)	16,1	SAMPLE DISTANCE BETWEEN 2nd LAST AND 1st PULSE
APB RS(0)	16,0	SAMPLE DISTANCE BETWEEN LAST AND 1st PULSE
APM RS(15)	17,15	INCREMENT (=1)

MULTI PULSE SUBROUTINE



MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: MULTI PULSE SUBROUTINE
FILE-NAME (NORD 10): PROG4:DATA
PROGRAM DESCRIPTION:

	APB PROCESSOR		APM PROCESSOR	
PC=1	RS(12)=F	F→Q-RS(13)	Q=F	F→Q-RS(15)
PC=2	RS(12)=F	F→RS(13)+RS(12)	DO NOTHING	
PC=3		F→RS(12)+RS(LC1)	Q=F	F→RS(15)+Q
PC=4		F→RS(12)+RS(LC1)	Q=F	F→RS(15)+Q
PC=5	Q=F	F→RS(12)+RS(LC1)	DO NOTHING	
PC=6	DO NOTHING		DO NOTHING	

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : MULTI PULSE SUBROUTINE

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	2	0	3	0	0	0
2	57	6	4	6	6	0	0	0	0	0
3	57	6	4	5	7	1	0	0	0	0
4	57	4	6	4	7	0	0	0	0	0
5	57	4	6	3	6	0	0	0	0	0
6	58	1	6	2	0	0	1	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	0	1	3	13	12	0
2	1	0	3	13	12	0
3	1	0	1	12	0	1
4	1	0	1	12	0	1
5	1	0	0	12	0	1
6	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	0	1	0	15	0
2	7	5	1	0	0
3	0	0	0	15	0
4	0	0	0	15	0
5	7	5	1	0	0
6	7	5	1	0	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	1	1	1	0	0	1	3	3	3	3	9	6
3	0	0	1	1	1	0	0	1	2	2	2	2	9	6
4	0	0	1	1	1	0	0	1	2	2	2	2	9	6
5	0	0	1	1	1	0	0	1	3	3	3	3	9	6
6	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	1	0	0	0
2	1	0	0	0	0	0	0
3	1	1	1	0	0	0	0
4	1	1	1	0	0	0	0
5	1	0	0	0	0	0	0
6	1	0	0	0	0	0	0

I/O INSTRUCTIONS DEFINED

MEM-LOC.	SETF	CLEARF	SELECT BUF.ADDR.	STROBE I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: MULTI PULSE SUBROUTINE (VERSION.2)
FILE-NAME (NORD 10): PROG8:DATA
PROGRAM DESCRIPTION:

DATA CHANNEL 1 $M_{XX,r} = \sum_{T=J_0}^{J_{N-1}} X^2_{T+r-1}$

DATA CHANNEL 2 $M_{YY,r} = \sum_{T=J_0}^{J_{N-1}} Y^2_{T+r-1}$

DATA CHANNEL 1 $K_{0,r} = \sum_{T=J_0}^{J_{N-1}} X^2_{T+r-1} + Y^2_{T+r-1}$

DATA CHANNEL 2 $M_{XY,r} = \sum_{T=J_0}^{J_{N-1}} X_{T+r-1} Y_{T+r-1}$

DATA CHANNEL 1 $Re\{K_{L,r}\} = X_{S+r-1}X_{S+L+r-1} + Y_{S+r-1}Y_{S+L+r-1}$

DATA CHANNEL 2 $Im\{K_{L,r}\} = X_{S+L+r-1}Y_{S+r-1} - X_{S+r-1}Y_{S+L+r-1}$

LET J_0=POSITION OF 1st PULSE
J_1=SAMPLE DIFFERENCE BETWEEN 1st AND 2nd PULSE
.
.
J_{N-1}=SAMPLE DIFFERENCE BETWEEN 1st AND Nth PULSE

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 - 8

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: MULTI PULSE SUBROUTINE (VERSION.2)
FILE-NAME (NORD 10): PROG8:DATA
PROGRAM DESCRIPTION:

WHERE $S=J_0,J_1,J_2,\ldots,J_{N-2}$

$L=J_1-S,J_2-S,\ldots,J_{N-1}-S$ WITH THE RESTRICTION $L>0$

$r=1,2,\ldots,M$ RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

MINIMUM NO. OF ELEMENT PULSES IN PULSE GROUP: 2
MAXIMUM NO. OF ELEMENT PULSES IN PULSE GROUP: 13

NOTES

1. The formulae above are given with respect to the way in which the X, Y samples are read from the buffer memory.
2. The Q registers of the APB, APM processors must be defined with the start addresses of the buffer, result memories in the main program.
3. The LCR1 register must be reloaded with the APBRS(15) register and the LCR2 register must be reloaded with the APBRS(14) register in the main program.
4. The zero lag is not computed in this algorithm, therefore to calculate the number of lags computed use the formula: $N(N-1)/2$ where N is the number of element pulses in the pulse group.
5. The $K_{0,r}$ value has no special significance and can later be ignored.

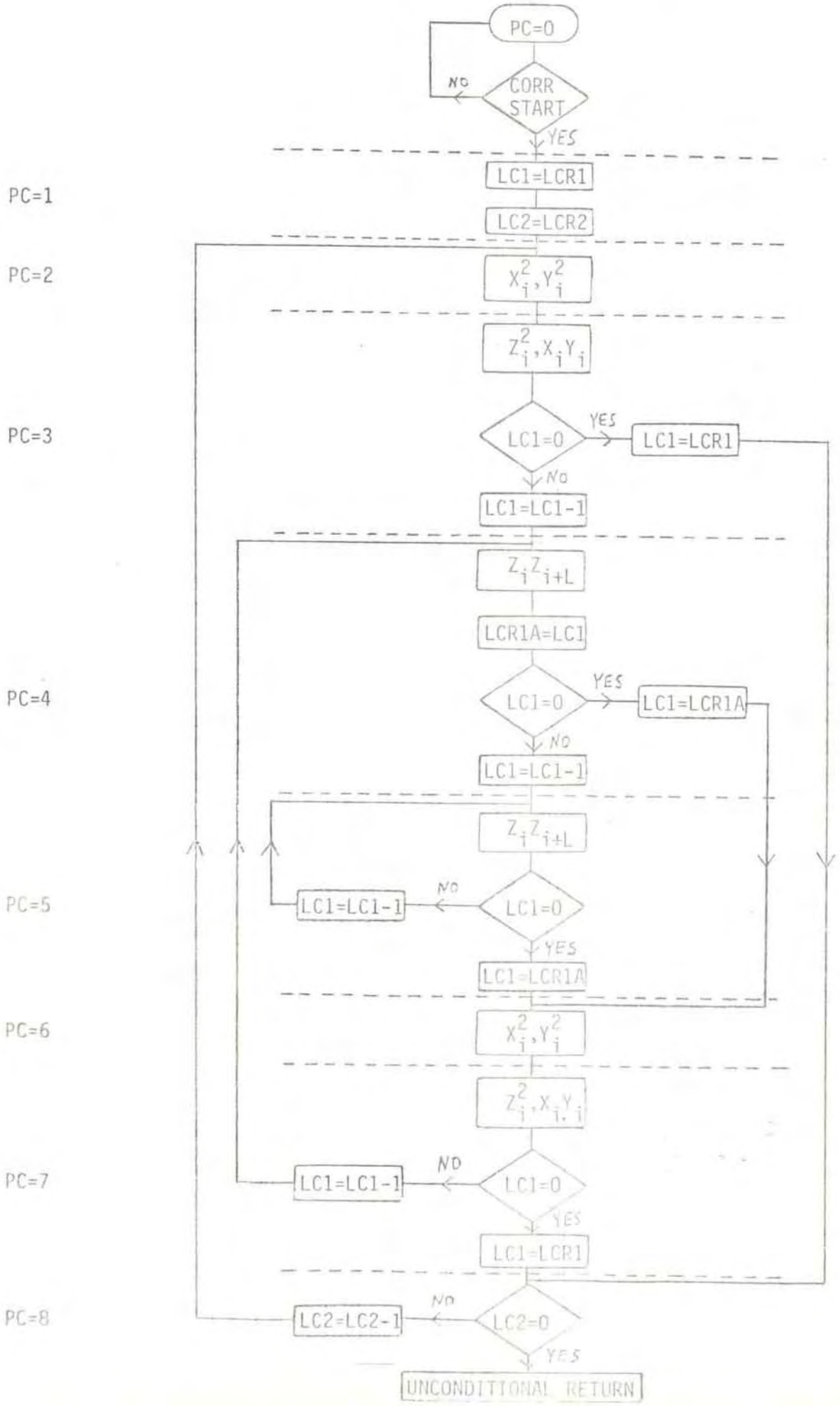
START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: MULTI PULSE SUBROUTINE (VERSION.2)
FILE-NAME (NORD 10): PROG8:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF SUBROUTINE
APB RS(15)	16,15	NO. OF PULSES-1 IN RANGECELL
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE
APB RS(13)	16,13	RANGECELL INCREMENT (NORMALLY=1)
APB RS(12)	16,12	TEMPORARY STORAGE
⋮		
APB RS(1)	16,1	SAMPLE DISTANCE BETWEEN 2nd LAST AND 1st PULSE
APB RS(0)	16,0	SAMPLE DISTANCE BETWEEN LAST AND 1st PULSE
APM RS(15)	17,15	INCREMENT (=1)
APM RS(14)	17,14	TEMPORARY STORAGE


PC=0
NO
CORR START
YES
PC=1
LC1=LCR1
LC2=LCR2
PC=2
X_i^2, Y_i^2
$Z_i^2, X_i Y_i$
PC=3
LC1=0
YES
LC1=LCR1
NO
LC1=LC1-1
$Z_i Z_{i+L}$
LCR1A=LC1
PC=4
LC1=0
YES
LC1=LCR1A
NO
LC1=LC1-1
$Z_i Z_{i+L}$
PC=5
LC1=LC1-1
NO
LC1=0
YES
LC1=LCR1A
PC=6
X_i^2, Y_i^2
$Z_i^2, X_i Y_i$
PC=7
LC1=LC1-1
NO
LC1=0
YES
LC1=LCR1
PC=8
LC2=LC2-1
NO
LC2=0
YES
UNCONDITIONAL RETURN

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: MULTI PULSE SUBROUTINE (VERSION.2)
FILE-NAME (NORD 10): PROG8:DATA
PROGRAM DESCRIPTION:

	APB PROCESSOR		APM PROCESSOR	
PC=1	RS(12)=F	F→Q-RS(13)	Q=F	F→Q-RS(15)
PC=2	RS(12)=F	F→RS(13)+RS(12)	RS(14)=F	F→RS(15)+Q
PC=3		F→RS(12)	Q=F	F→RS(15)+RS(14)
PC=4		F→RS(12)+RS(LC1)	Q=F	F→RS(15)+Q
PC=5		F→RS(12)+RS(LC1)	Q=F	F→RS(15)+Q
PC=6	Q=F	F→RS(12)+RS(LC1)		F→RS(14)
PC=7		F→Q		F→RS(14)+RS(15)
PC=8	DO NOTHING		DO NOTHING	

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : MULTI PULSE SUBROUTINE (VER.2)

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	2	0	3	0	0	0
2	56	0	4	0	0	0	0	0	0	0
3	57	6	4	6	6	0	0	0	0	0
4	57	6	4	6	7	1	0	0	0	0
5	57	4	6	5	7	0	0	0	0	0
6	56	0	4	0	0	0	0	0	0	0
7	57	4	6	4	6	0	0	0	0	0
8	56	1	6	2	0	0	1	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	0	1	3	13	12	0
2	1	0	3	13	12	0
3	4	0	1	12	0	0
4	1	0	1	12	0	1
5	1	0	1	12	0	1
6	1	0	0	12	0	1
7	2	0	1	0	0	0
8	7	5	1	0	0	0

APA-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	0	1	3	15	0
2	0	0	3	15	14
3	1	0	0	15	14
4	0	0	0	15	0
5	0	0	0	15	0
6	4	0	1	14	0
7	1	0	1	15	14
8	7	5	1	0	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	1	1	0	0	1	1	3	3	3	3	15	5
3	0	0	1	1	1	0	0	1	3	3	3	3	9	15
4	0	0	1	1	1	0	0	1	2	2	2	2	9	5
5	0	0	1	1	1	0	0	1	2	2	2	2	9	6
6	0	0	1	1	0	0	1	1	3	3	3	3	15	5
7	0	0	1	1	1	0	0	1	3	3	3	3	9	15
8	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	1	0	0	0
2	1	1	1	1	0	0	0
3	1	1	1	0	0	0	0
4	1	1	1	1	0	0	0
5	1	1	1	0	0	0	0
6	1	1	1	0	1	0	0
7	1	1	1	0	0	0	0
8	1	0	0	0	0	0	0

I/O INSTRUCTIONS DEFINED

MEM-LOC.	SETF	CLEARF	SELECT	BUF.ADDR.	STROBE	I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0		0	0	0	0
1	0	0	0		0	0	0	0
2	0	0	0		0	0	0	0
3	0	0	0		0	0	0	0
4	0	0	0		0	0	0	0
5	0	0	0		0	0	0	0
6	0	0	0		0	0	0	0
7	0	0	0		0	0	0	0
8	0	0	0		0	0	0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT	CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: CROSS CORRELATION SUBROUTINE (NO. OF LAGS .EQ. NO. OF SAMPLES)
FILE-NAME (NORD 10): PROG5:DATA
PROGRAM DESCRIPTION:

DATA CHANNEL 1

$$\mathrm{Re}\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+(N+D-1)(r-1)} X_{i+S+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1)}\right)$$

DATA CHANNEL 2

$$\mathrm{Im}\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+S+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1)}\right)$$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=0,1,2,...,N-1
S=SAMPLE DIFFERENCE BETWEEN THE TWO SETS OF DATA
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND ≤0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

MINIMUM NO. OF SAMPLES IN RANGEDATA: 1

NOTES

1. The formulae above are given with respect to the way in which the X, Y samples are read from the buffer memory.
2. The Q registers of the APB, APM processors must be defined with the start addresses of the buffer, result memories in the main program.
3. The LCR1 register must be reloaded with the APBRS(15) register and the LCR2 register must be reloaded with the APBRS(14) register in the main program.
4. Only half of the correlation function can be obtained with this scheme.
5. The Single Pulse autocorrelation scheme (see PROG2:DATA) can be obtained by setting APBRS(12)=0.

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 - 8

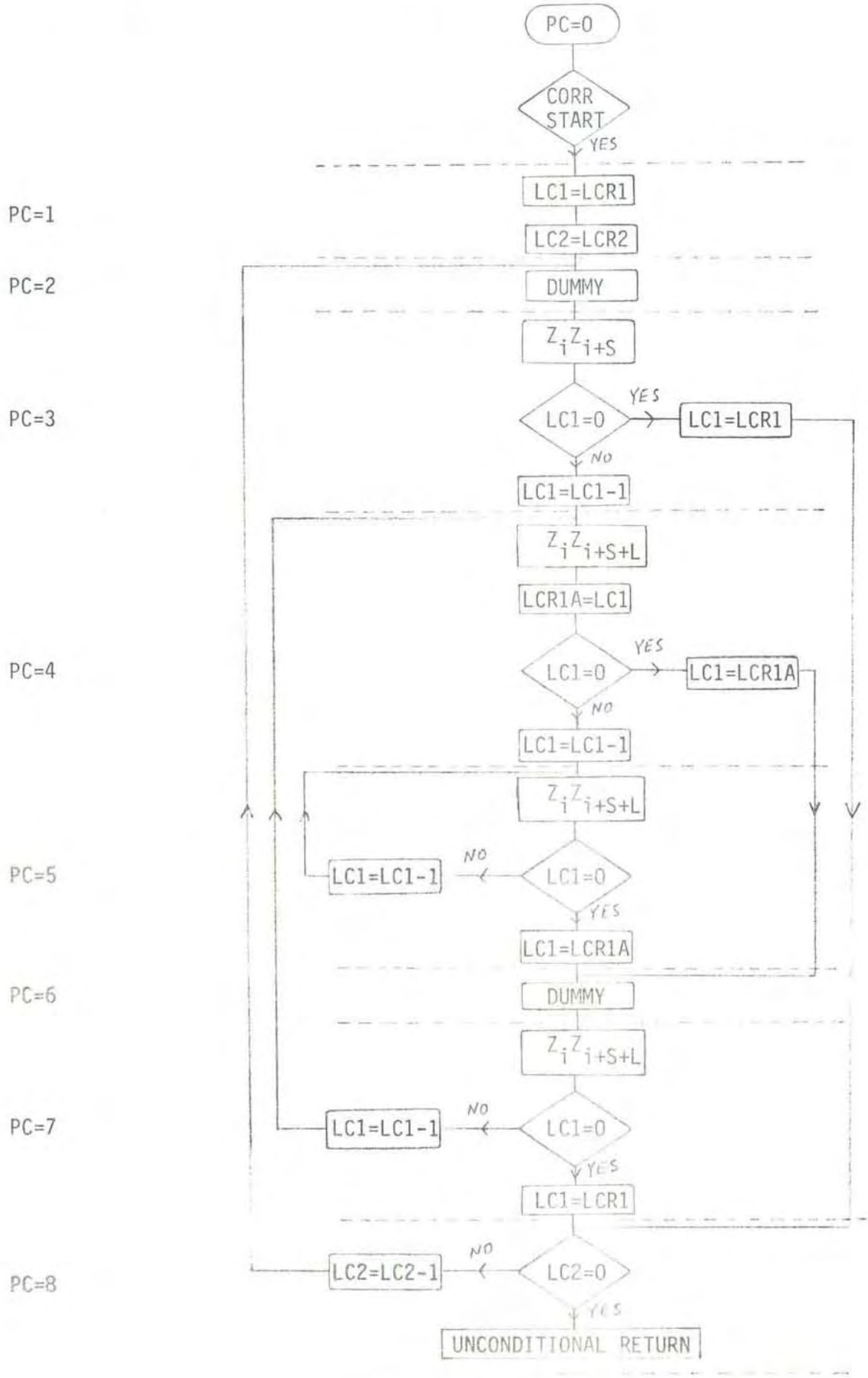
MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: CROSS CORRELATION SUBROUTINE (NO. OF LAGS .EQ. NO. OF SAMPLES)
FILE-NAME (NORD 10): PROG5:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF SUBROUTINE
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE
APB RS(13)	16,13	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS)
APB RS(12)	16,12	START ADDRESS OF 2nd FIELD-START ADDRESS OF 1st FIELD
APB RS(11)	16,11	SAMPLE INCREMENT (NORMALLY=1)
APB RS(10)	16,10	TEMPORARY STORAGE
APM RS(15)	17,15	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED)
APM RS(14)	17,14	INCREMENT (=1)
APM RS(13)	17,13	TEMPORARY STORAGE

CROSS CORRELATION SUBROUTINE (NO. OF LAGS .EQ. NO. OF SAMPLES)



MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: CROSS CORRELATION SUBROUTINE (NO. OF LAGS .EQ. NO. OF SAMPLES)
FILE-NAME (NORD 10): PROG5:DATA
PROGRAM DESCRIPTION:

	APB PROCESSOR		APM PROCESSOR	
PC=1	Q=F	F→Q-RS(13)	Q=F	F→Q-RS(15)
PC=2	Q=F	F→RS(13)+Q	DO NOTHING	
PC=3	RS(10)=F	F→RS(12)+Q	Q=F	F→RS(15)+Q
PC=4	RS(10)=F	F→RS(11)+RS(10)	RS(13)=F	F→RS(14)+Q
PC=5	RS(10)=F	F→RS(11)+RS(10)	RS(13)=F	F→RS(14)+RS(13)
PC=6	Q=F	F→RS(11)+Q	DO NOTHING	
PC=7	RS(10)=F	F→RS(12)+Q		F→Q
PC=8	DO NOTHING		DO NOTHING	

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : CROSS CORRELATION SUBROUTINE (NO. OF LAGS .EQ. N OF SAMPLES

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	2	0	3	0	0	0
2	56	0	4	0	0	0	0	0	0	0
3	57	6	4	8	6	0	0	0	0	0
4	57	6	4	6	7	1	0	0	0	0
5	57	4	6	5	7	0	0	0	0	0
6	56	0	4	0	0	0	0	0	0	0
7	57	4	6	4	6	0	0	0	0	0
8	58	1	6	2	0	0	1	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	0	1	0	13	0	0
2	0	0	0	13	0	0
3	0	0	3	12	10	0
4	1	0	3	11	10	0
5	1	0	3	11	10	0
6	0	0	0	11	0	0
7	0	0	3	12	10	0
8	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	0	1	0	15	0
2	7	5	1	0	0
3	0	0	0	15	0
4	0	0	3	14	13
5	1	0	3	14	13
6	7	5	1	0	0
7	2	0	1	0	0
8	7	5	1	0	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	1	1	1	0	0	1	1	1	1	1	9	6
3	0	0	1	1	1	0	0	1	2	2	2	2	9	6
4	0	0	1	1	1	0	0	1	2	2	2	2	9	6
5	0	0	1	1	1	0	0	1	2	2	2	2	9	6
6	0	0	1	1	1	0	0	1	1	1	1	1	9	6
7	0	0	1	1	1	0	0	1	2	2	2	2	9	6
8	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	1	0	0	0
2	1	0	0	0	0	0	0
3	1	1	1	1	0	0	0
4	1	1	1	0	0	0	0
5	1	1	1	0	0	0	0
6	1	0	0	0	0	0	0
7	1	1	1	0	1	0	0
8	1	0	0	0	0	0	0

I/O INSTRUCTIONS DEFINED

MEM-LOC.	SETF	CLEARF	SELECT BUF.ADDR.	STROBE	I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0	0	0	0	
1	0	0	0	0	0	0	
2	0	0	0	0	0	0	
3	0	0	0	0	0	0	
4	0	0	0	0	0	0	
5	0	0	0	0	0	0	
6	0	0	0	0	0	0	
7	0	0	0	0	0	0	
8	0	0	0	0	0	0	

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: CROSS CORRELATION SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES)
FILE-NAME (NORD 10): PROG6:DATA
PROGRAM DESCRIPTION:

DATA CHANNEL 1

$$\mathrm{Re}\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+(N+D-1)(r-1)} X_{i+S+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1)}\right)$$

DATA CHANNEL 2

$$\mathrm{Im}\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+S+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1)}\right)$$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=0,1,2,...,P P≤N-1
S=SAMPLE DIFFERENCE BETWEEN THE TWO SETS OF DATA
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND≤0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

MINIMUM NO. OF SAMPLES IN RANGEDATA: 1

MINIMUM NO. OF LAGS IN RANGEDATA: 2

NOTES

1. The formulae above are given with respect to the way in which the X, Y samples are read from the buffer memory.
2. The Q registers of the APB, APM processors must be defined with the start addresses of the buffer, result memories in the main program.
3. The LCR1 register must be reloaded with the APBRS(15) register, the LCR2 register must be reloaded with the APBRS(14) register and the LCR3 register must be reloaded with the APBRS(13) register in the main program.
4. Only half of the correlation function can be obtained with this scheme.
5. The Single Pulse autocorrelation scheme (see PROG3:DATA) can be obtained by setting APBRS(11)=0.

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 - 8

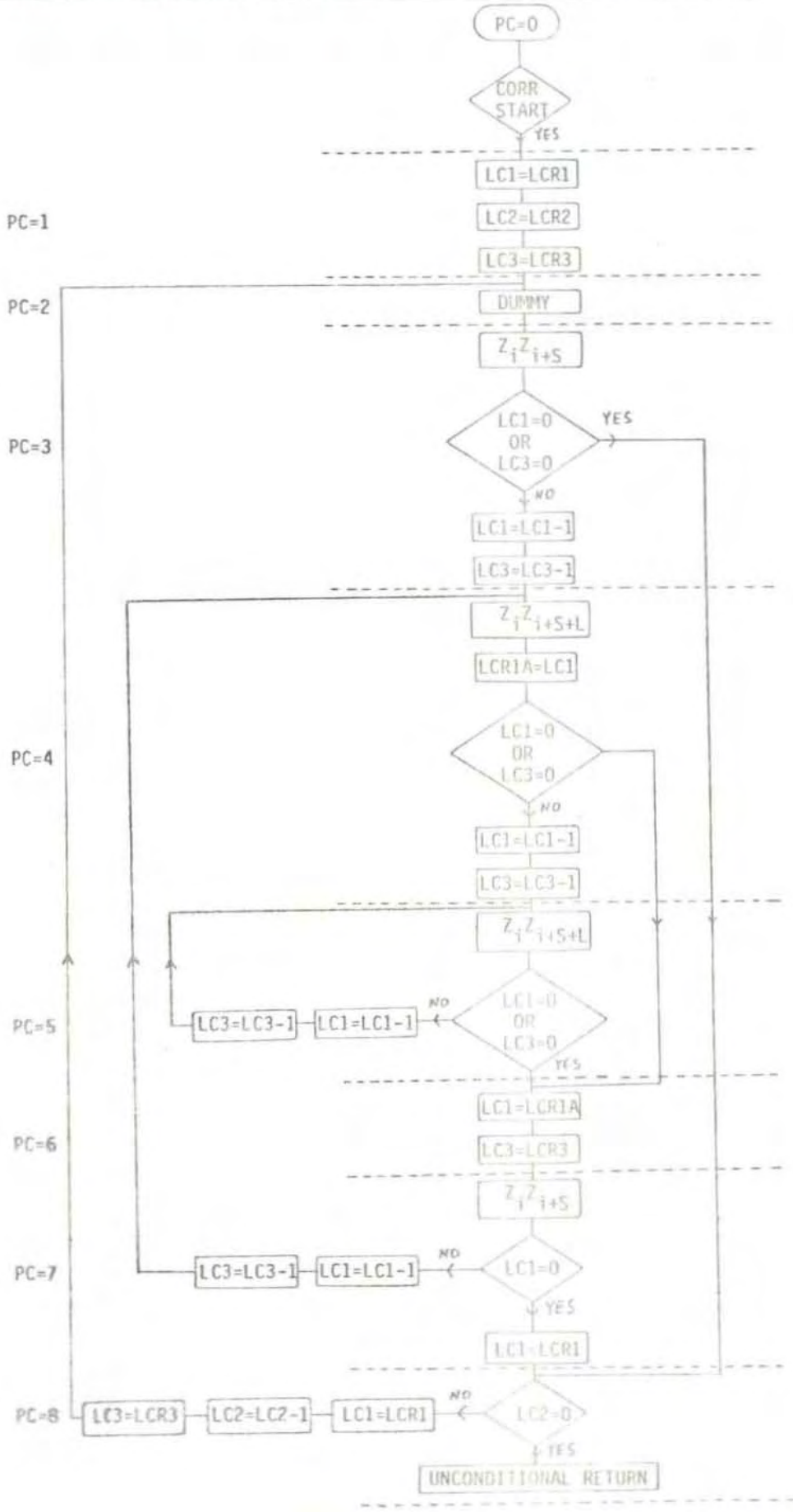
MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: CROSS CORRELATION SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES)
FILE-NAME (NORD 10): PROG6:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF SUBROUTINE
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE
APB RS(13)	16,13	NO. OF LAGS-1 IN RANGECELL
APB RS(12)	16,12	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS)
APB RS(11)	16,11	START ADDRESS OF 2nd FIELD-START ADDRESS OF 1st FIELD
APB RS(10)	16,10	SAMPLE INCREMENT (NORMALLY=1)
APB RS(9)	16,9	TEMPORARY STORAGE
APM RS(15)	17,15	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED)
APM RS(14)	17,14	INCREMENT (=1)
APM RS(13)	17,13	TEMPORARY STORAGE

CROSS CORRELATION SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES)



MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: CROSS CORRELATION SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES)
FILE-NAME (NORD 10): PROG6:DATA
PROGRAM DESCRIPTION:

	APB PROCESSOR			APM PROCESSOR	
PC=1		Q=F	F→Q-RS(12)	Q=F	F→Q-RS(15)
PC=2		Q=F	F→RS(12)+Q	DO NOTHING	
PC=3	RS(9)=F		F→RS(11)+Q	Q=F	F→RS(15)+Q
PC=4	RS(9)=F		F→RS(10)+RS(9)	RS(13)=F	F→RS(14)+Q
PC=5	RS(9)=F		F→RS(10)+RS(9)	RS(13)=F	F→RS(14)+RS(13)
PC=6		Q=F	F→RS(10)+Q	DO NOTHING	
PC=7	RS(9)=F		F→RS(11)+Q		F→Q
PC=8	DO NOTHING			DO NOTHING	

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : CROSS CORRELATION SUBROUTINE (NO. OF LAGS .LE. NO OF SAMPLES)

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	2	0	3	2	0	0
2	56	0	4	0	0	0	0	0	0	0
3	61	6	4	8	1	0	0	1	0	0
4	61	6	4	6	1	1	0	1	0	0
5	61	4	6	5	1	0	0	1	0	0
6	56	0	4	0	3	0	0	2	0	0
7	57	4	6	4	6	0	0	1	0	0
8	58	1	6	2	2	0	1	2	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	0	1	0	12	0	0
2	0	0	0	12	0	0
3	0	0	3	11	9	0
4	1	0	3	10	9	0
5	1	0	3	10	9	0
6	0	0	0	10	0	0
7	0	0	3	11	9	0
8	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	0	1	0	15	0
2	7	5	1	0	0
3	0	0	0	15	0
4	0	0	3	14	13
5	1	0	3	14	13
6	7	5	1	0	0
7	2	0	1	0	0
8	7	5	1	0	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	1	1	1	0	0	1	1	1	1	1	9	6
3	0	0	1	1	1	0	0	1	2	2	2	2	9	6
4	0	0	1	1	1	0	0	1	2	2	2	2	9	6
5	0	0	1	1	1	0	0	1	2	2	2	2	9	6
6	0	0	1	1	1	0	0	1	1	1	1	1	9	6
7	0	0	1	1	1	0	0	1	2	2	2	2	9	6
8	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	1	0	0	0
2	1	0	0	0	0	0	0
3	1	1	1	1	0	0	0
4	1	1	1	0	0	0	0
5	1	1	1	0	0	0	0
6	1	0	0	0	0	0	0
7	1	1	1	0	1	0	0

I/O INSTRUCTIONS DEFINED

MEM-LOC.	SETF	CLEARF	SELECT BUF.ADDR.	STROBE I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: CROSS CORRELATION SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES) (VERSION.2)
FILE-NAME (NORD 10): PROG7:DATA
PROGRAM DESCRIPTION:

FOR NEGATIVE HALF OF CCF:

DATA CHANNEL 1

$$Re\left\{K_{L,r}\right\} = \sum_{i=0}^{N-|L|-1} (X_{i+|L|+(N+D-1)(r-1)} X_{i+S+(N+D-1)(r-1)} + Y_{i+|L|+(N+D-1)(r-1)} Y_{i+S+(N+D-1)(r-1)})$$

DATA CHANNEL 2

$$Im\left\{K_{L,r}\right\} = \sum_{i=0}^{N-|L|-1} (X_{i+S+(N+D-1)(r-1)} Y_{i+|L|+(N+D-1)(r-1)} - X_{i+|L|+(N+D-1)(r-1)} Y_{i+S+(N+D-1)(r-1)})$$

FOR $L=-1,-2,\ldots,-P$ $\quad P \leqslant N-1$

FOR POSITIVE HALF OF CCF:

DATA CHANNEL 1

$$Re\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} (X_{i+(N+D-1)(r-1)} X_{i+S+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1}$$

DATA CHANNEL 2

$$Im\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} (X_{i+S+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1)}$$

FOR $L=0,1,2,\ldots,P$ $\quad P \leqslant N-1$

WHERE N=NO. OF SAMPLES IN RANGECELL

S=SAMPLE DIFFERENCE BETWEEN THE TWO SETS OF DATA

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 - 14

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: CROSS CORRELATION SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES) (VERSION.2)
FILE-NAME (NORD 10): PROG7:DATA
PROGRAM DESCRIPTION:

D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND ≤0 FOR OVERLAPPING)

r=1,2,...,M RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

MINIMUM NO. OF SAMPLES IN RANGEDATA: 1

MINIMUM NO. OF POSITIVE LAGS IN RANGEDATA: 2

NOTES

1. The formulae above are given with respect to the way in which the X, Y samples are read from the buffer memory.
2. The Q registers of the APB, APM processors must be defined with the start addresses of the buffer, result memories in the main program.
3. The LCR1 register must be reloaded with the APBRS(15) register, the LCR2 register must be reloaded with the APBRS(14) register and the LCR3 register must be reloaded with the APBRS(13) register in the main program.
4. The Single Pulse autocorrelation scheme with positive and negative lags (compare with PROG3:DATA) can be obtained by setting APBRS(11)=0.
5. The lags are written in the result memory in the following way:
   L(-P),L(-P+1),....,L(0),L(1),....L(P) P≤N-1

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

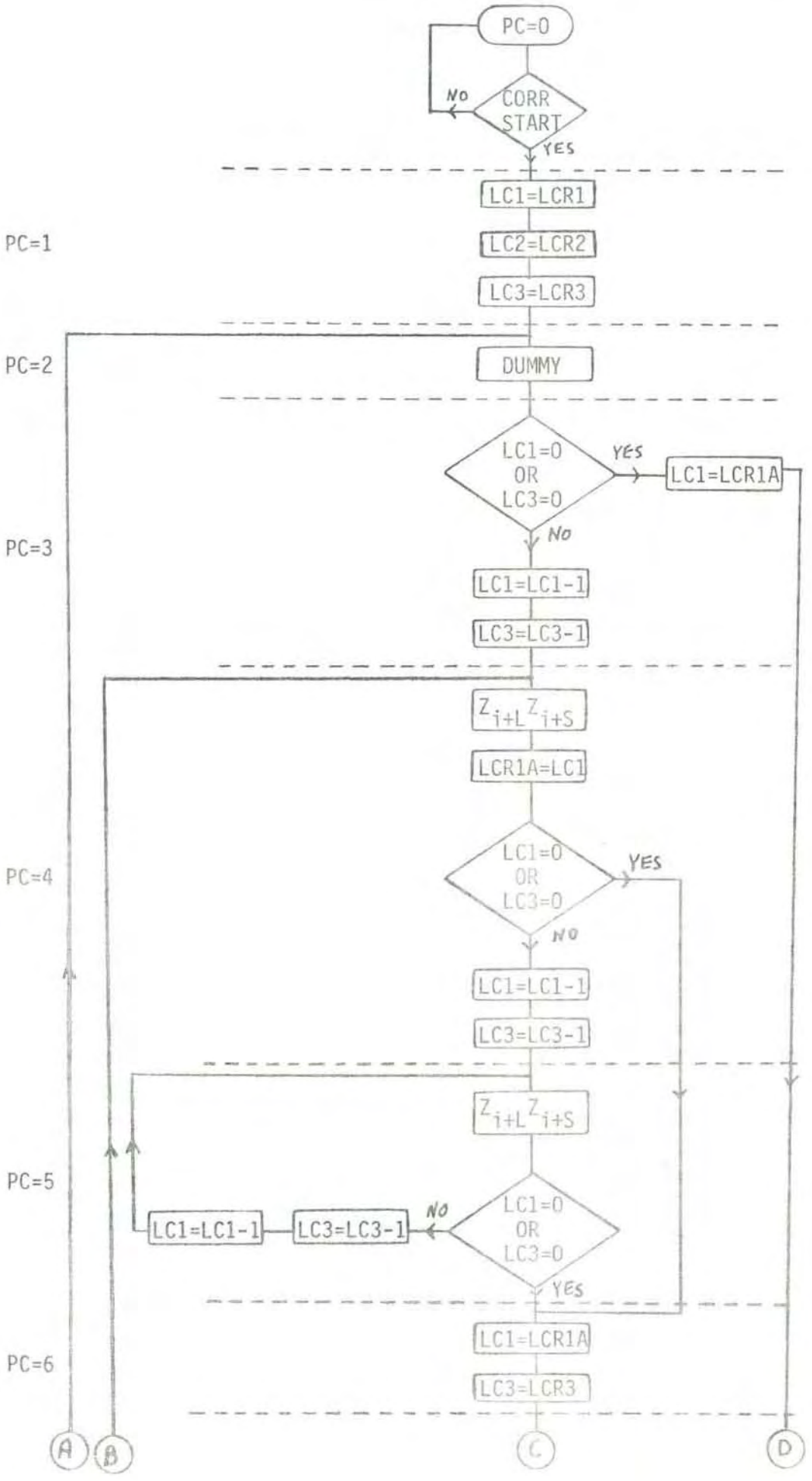
AUTOR: TERRANCE HO

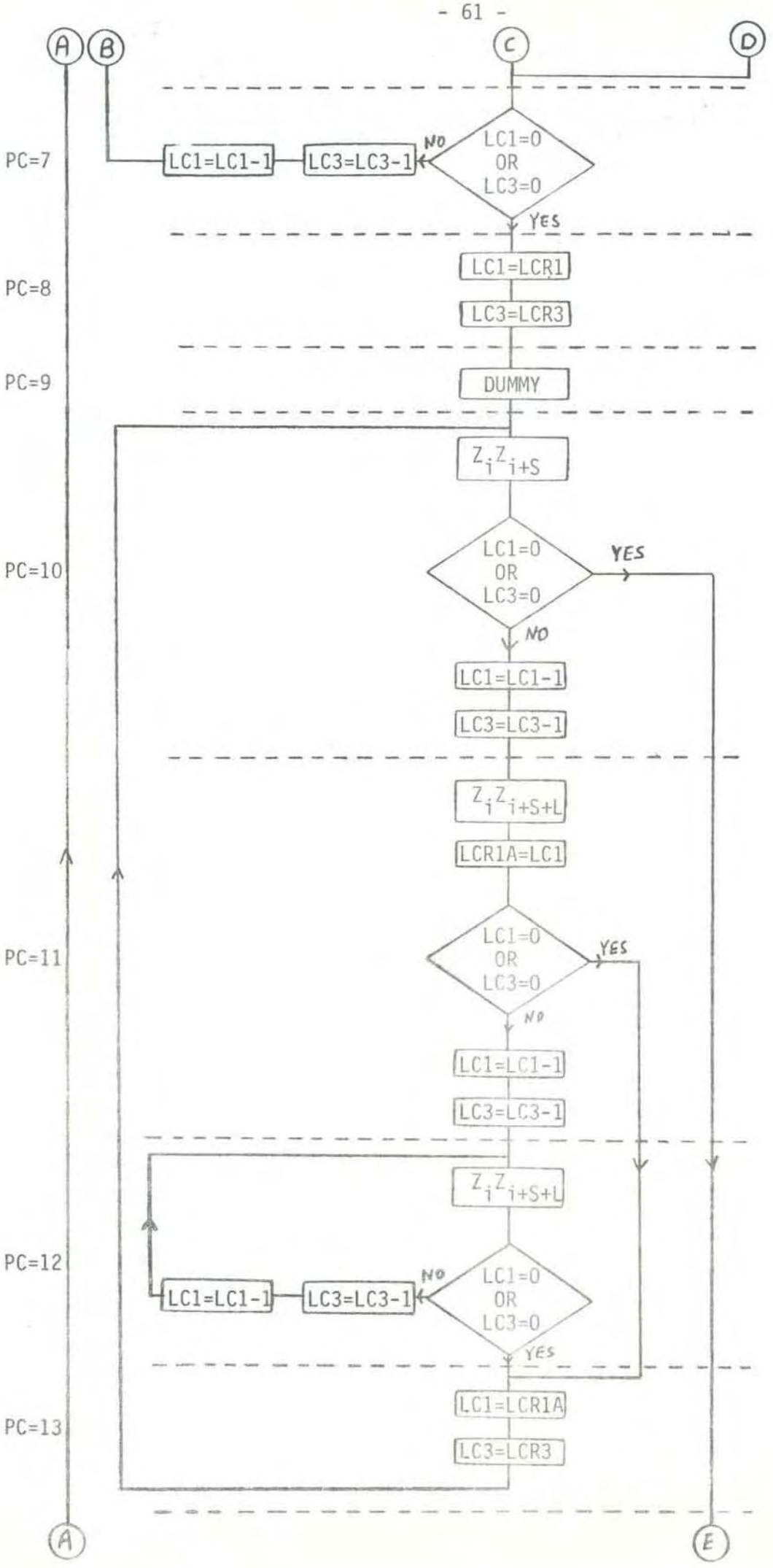
DATE: 6/8/80

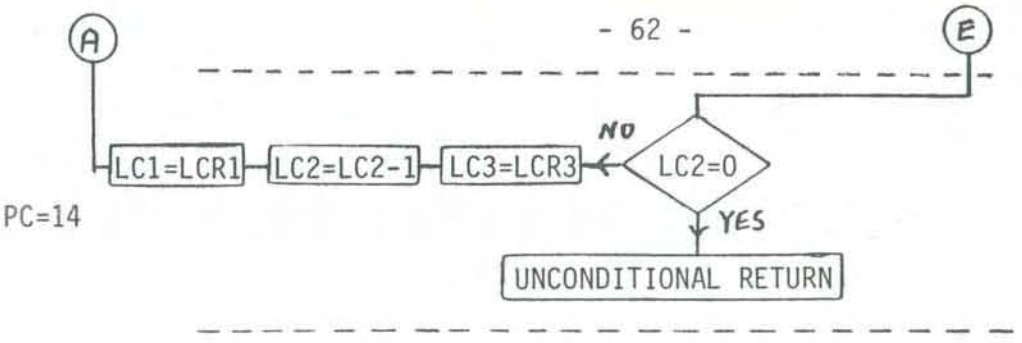
PROGRAM NAME: CROSS CORRELATION SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES) (VERSION.
FILE-NAME (NORD 10): PROG7:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF SUBROUTINE
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE
APB RS(13)	16,13	NO. OF LAGS-1 IN RANGECELL (0-P P$\leqslant$N-1
APB RS(12)	16,12	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS)
APB RS(11)	16,11	START ADDRESS OF 2nd FIELD-START ADDRESS IF 1st FIELD
APB RS(10)	16,10	SAMPLE INCREMENT (NORMALLY=1)
APB RS(9)	16,9	TEMPORARY STORAGE
APM RS(15)	17,15	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED 0-P P$\leqslant$N-1)
APM RS(14)	17,14	INCREMENT (=1)
APM RS(13)	17,13	TEMPORARY STORAGE
APM RS(12)	17,12	2
APM RS(11)	17,11	2*APM RS(15)

CROSS CORRELATION SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES) (VERSION. 2)




A
B
C
D
PC=7
LC1=LC1-1
LC3=LC3-1
NO
LC1=0
OR
LC3=0
YES
PC=8
LC1=LCR1
LC3=LCR3
PC=9
DUMMY
PC=10
Z_iZ_{i+S}
LC1=0
OR
LC3=0
YES
NO
LC1=LC1-1
LC3=LC3-1
Z_iZ_{i+S+L}
LCR1A=LC1
PC=11
LC1=0
OR
LC3=0
YES
NO
LC1=LC1-1
LC3=LC3-1
Z_iZ_{i+S+L}
PC=12
LC1=LC1-1
LC3=LC3-1
NO
LC1=0
OR
LC3=0
YES
PC=13
LC1=LCR1A
LC3=LCR3
A
E


A
E
LC1=LCR1
LC2=LC2-1
LC3=LCR3
NO
LC2=0
YES
UNCONDITIONAL RETURN

PC=14

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: CROSS CORRELATION SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES (VERSION.2
FILE-NAME (NORD 10): PROG7:DATA
PROGRAM DESCRIPTION:

	APB PROCESSOR			APM PROCESSOR	
PC=1		Q=F	F→Q-RS(12)	Q=F	F→Q-RS(15)
PC=2	RS(9)=F		F→RS(12)+Q	Q=F	F→RS(11)+Q
PC=3		Q=F	F→RS(11)+RS(9)	Q=F	F→Q-RS(12)
PC=4	RS(9)=F		F→RS(10)+RS(9)	RS(13)=F	F→Q
PC=5	RS(9)=F		F→RS(10)+RS(9)	RS(13)=F	F→RS(13)-RS(14)
PC=6		Q=F	F→RS(10)+Q	DO NOTHING	
PC=7	RS(9)=F		F→Q-RS(11)	DO NOTHING	
PC=8		Q=F	F→RS(9)-RS(15)	DO NOTHING	
PC=9			F→Q	Q=F	F→RS(14)+Q
PC=10	RS(9)=F		F→RS(11)+Q		F→Q
PC=11	RS(9)=F		F→RS(10)+RS(9)	RS(13)=F	F→RS(14)+Q
PC=12	RS(9)=F		F→RS(10)+RS(9)	RS(13)=F	F→RS(14)+RS(13)
PC=13		Q=F	F→RS(10)+Q	DO NOTHING	
PC=14	DO NOTHING			DO NOTHING	

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : CROSS CORRELATION SUBROUTINE (NO. OF LAGS .LE. NO. OF SAMPLES) (VER.2)

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	2	0	3	2	0	0
2	56	0	4	0	0	0	0	0	0	0
3	61	6	4	7	5	1	0	1	0	0
4	61	6	4	6	1	1	0	1	0	0
5	61	4	6	5	1	0	0	1	0	0
6	56	0	4	0	3	0	0	2	0	0
7	61	4	6	4	1	0	0	1	0	0
8	56	0	4	0	2	0	0	2	0	0
9	56	0	4	0	0	0	0	0	0	0
10	61	6	4	14	1	0	0	1	0	0
11	61	6	4	13	1	1	0	1	0	0
12	61	4	6	12	1	0	0	1	0	0
13	56	0	6	10	3	0	0	2	0	0
14	58	1	6	2	2	0	1	2	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	0	1	0	12	0	0
2	0	0	0	12	9	0
3	1	0	0	11	9	0
4	1	0	3	10	9	0
5	1	0	3	10	9	0
6	0	0	0	10	0	0
7	0	1	3	11	9	0
8	1	2	0	9	15	0
9	2	0	1	0	0	0
10	0	0	3	11	9	0
11	1	0	3	10	9	0
12	1	0	3	10	9	0
13	0	0	0	10	0	0
14	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	0	1	0	15	0
2	0	0	0	11	0
3	0	1	0	12	0
4	2	0	3	0	13
5	1	1	3	14	13
6	7	5	1	0	0
7	7	5	1	0	0
8	7	5	1	0	0
9	0	0	0	14	0
10	2	0	1	0	0
11	0	0	3	14	13
12	1	0	3	14	13
13	7	5	1	0	0
14	7	5	1	0	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	0	0	0	0	0	0	0	0	0	0	15	15
3	0	0	1	1	0	1	1	0	1	1	1	1	9	6
4	0	0	1	1	0	1	1	0	2	2	2	2	9	6
5	0	0	1	1	0	1	1	0	2	2	2	2	9	6
6	0	0	1	1	0	1	1	0	1	1	1	1	9	6
7	0	0	0	0	0	0	0	0	0	0	0	0	15	15
8	0	0	0	0	0	0	0	0	0	0	0	0	15	15
9	0	0	1	1	1	0	0	1	1	1	1	1	9	6
10	0	0	1	1	1	0	0	1	2	2	2	2	9	6
11	0	0	1	1	1	0	0	1	2	2	2	2	9	6
12	0	0	1	1	1	0	0	1	2	2	2	2	9	6
13	0	0	1	1	1	0	0	1	1	1	1	1	9	6
14	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	1	0	0	0
2	1	0	0	0	0	0	0
3	1	0	0	0	0	0	0
4	1	1	1	0	0	0	0
5	1	1	1	0	0	0	0
6	1	0	0	0	0	0	0
7	1	0	0	0	1	0	0
8	1	0	0	1	0	0	0
9	1	0	0	0	0	0	0
10	1	1	1	0	0	0	0
11	1	1	1	0	0	0	0
12	1	1	1	0	0	0	0
13	1	0	0	0	1	0	0
14	1	0	0	1	0	0	0

I/O INSTRUCTIONS DEFINED

MEM-LOC.	SETF	CLEARF	SELECT BUF.ADDR.	STROBE I-REG.	ENABLE EDB	ENABLE EA
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: TRANSFER PROGRAM
FILE-NAME (NORD 10): PROG27:DATA
PROGRAM DESCRIPTION:

The Transfer program enables the transfer of the 64 BIT words of the correlator result memory as 4x16 BIT words to the NORD 10 computer. The way in which the 64 BIT words are split up and the order in which they are transferred are:

TRANSFERRED 1st	MOST SIGNIFICANT BITS	DATA CHANNEL 1
TRANSFERRED 2nd	LEAST SIGNIFICANT BITS	DATA CHANNEL 1
TRANSFERRED 3rd	MOST SIGNIFICANT BITS	DATA CHANNEL 2
TRANSFERRED 4th	LEAST SIGNIFICANT BITS	DATA CHANNEL 2

The STATUS and CONTROL words of the correlator are transferred out before the data to the NORD 10 computer. The transfer of these two words are set in the program and must not be included in the parameter for the number of 64 BIT words for DMA transfer.

START ADDRESS FOR PROGRAM: 32
PROGRAM-MEMORY LOCATIONS USED: 32 - 44

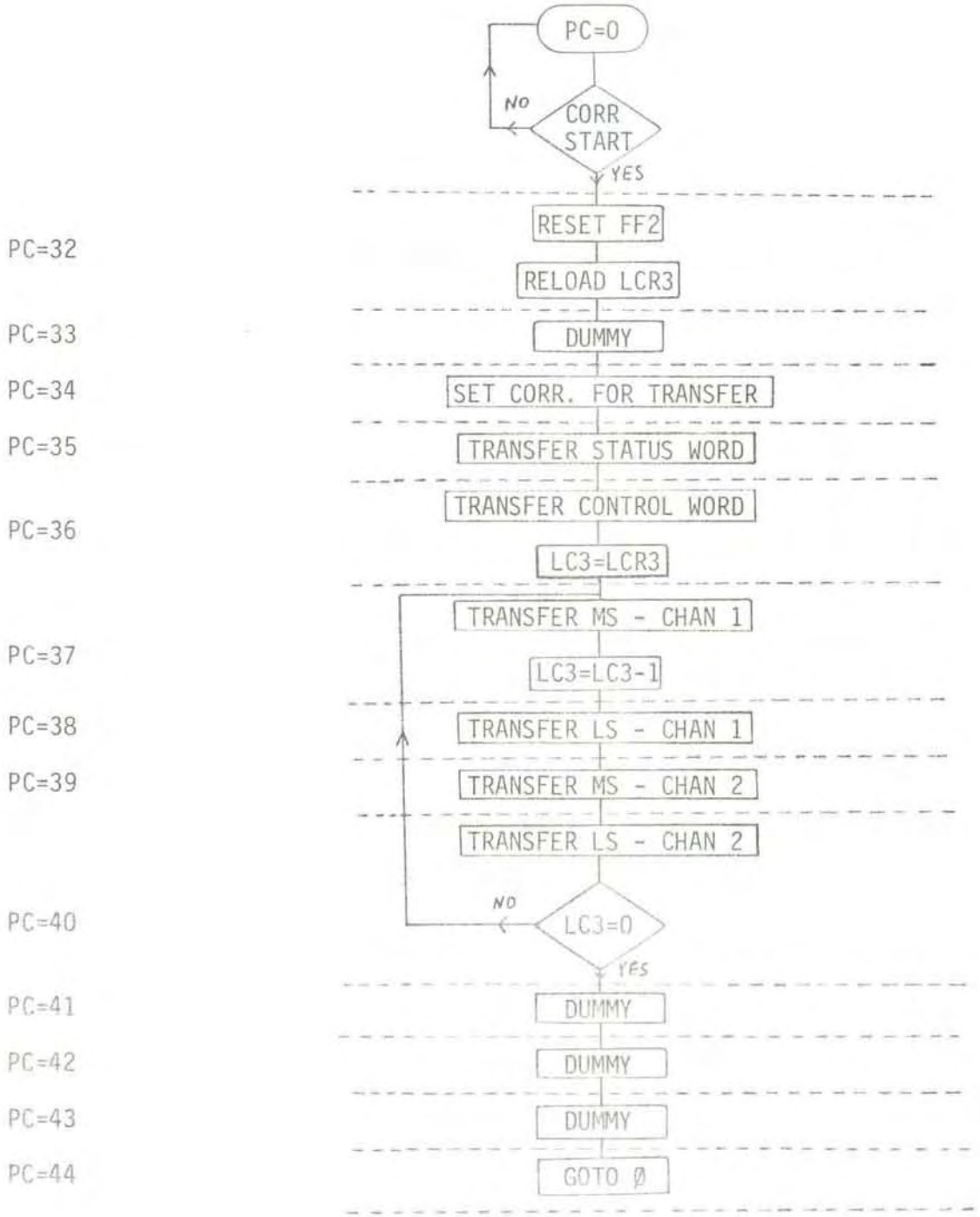
MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO , DATE: 6/8/80

PROGRAM NAME: TRANSFER PROGRAM
FILE-NAME (NORD 10): PROG27:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
DATAI REGISTER, APB	6	NO. OF 64 BIT WORDS FOR DMA TRANSFER
APM RS(0)	17,0	INCREMENT (=1)

TRANSFER PROGRAM



MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: TRANSFER PROGRAM
FILE-NAME (NORD 10): PROG27:DATA
PROGRAM DESCRIPTION:

	APB PROCESSOR	APM PROCESSOR
PC=32	F→DATAI	DO NOTHING
PC=33	DO NOTHING	DO NOTHING
PC=34	DO NOTHING	DO NOTHING
PC=35	DO NOTHING	Q=F .F→DATAI .AND. 0
PC=36	DO NOTHING	Q=F F→Q-RS(0)
PC=37	DO NOTHING	Q=F F→RS(0)+Q
PC=38	DO NOTHING	F→Q
PC=39	DO NOTHING	F→Q
PC=40	DO NOTHING	F→Q
PC=41	DO NOTHING	DO NOTHING
PC=42	DO NOTHING	DO NOTHING
PC=43	DO NOTHING	DO NOTHING
PC=44	DO NOTHING	DO NOTHING

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : TRANSFER PROGRAM WITH STATUS AND CONTROL WORDS X-FERRED

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
32	56	0	4	0	0	0	0	0	1	20
33	56	0	4	0	0	0	0	0	0	0
34	56	0	4	0	0	0	0	0	0	0
35	56	0	4	0	0	0	0	0	0	0
36	56	0	8	0	0	0	0	2	0	0
37	56	0	4	0	0	0	0	1	0	0
38	56	0	4	0	0	0	0	0	0	0
39	56	0	4	0	0	0	0	0	0	0
40	60	0	5	0	0	0	0	0	0	0
41	56	0	4	0	0	0	0	0	0	0
42	56	0	4	0	0	0	0	0	0	0
43	56	0	4	0	0	0	0	0	0	0
44	56	0	6	0	0	0	0	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
32	7	0	1	0	0	0
33	7	5	1	0	0	0
34	7	5	1	0	0	0
35	7	5	1	0	0	0
36	7	5	1	0	0	0
37	7	5	1	0	0	0
38	7	5	1	0	0	0
39	7	5	1	0	0	0
40	7	5	1	0	0	0
41	7	5	1	0	0	0
42	7	5	1	0	0	0
43	7	5	1	0	0	0
44	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
32	7	5	1	0	0
33	7	5	1	0	0
34	7	5	1	0	0
35	7	5	0	0	0
36	0	1	0	0	0
37	0	0	0	0	0
38	2	0	1	0	0
39	2	0	1	0	0
40	2	0	1	0	0
41	7	5	1	0	0
42	7	5	1	0	0
43	7	5	1	0	0
44	7	5	1	0	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
32	0	0	0	0	0	0	0	0	0	0	0	0	15	15
33	0	0	0	0	0	0	0	0	0	0	0	0	15	15
34	0	0	0	0	0	0	0	0	0	0	0	0	15	15
35	0	0	0	0	0	0	0	0	0	0	0	0	15	15
36	0	0	0	0	0	0	0	0	0	0	0	0	15	15
37	0	0	0	0	0	0	0	0	0	0	0	0	15	15
38	0	0	0	0	0	0	0	0	0	0	0	0	15	15
39	0	0	0	0	0	0	0	0	0	0	0	0	15	15
40	0	0	0	0	0	0	0	0	0	0	0	0	15	15
41	0	0	0	0	0	0	0	0	0	0	0	0	15	15
42	0	0	0	0	0	0	0	0	0	0	0	0	15	15
43	0	0	0	0	0	0	0	0	0	0	0	0	15	15
44	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
32	0	0	0	0	0	1	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0

I/O INSTRUCTIONS DEFINED

MEM-LOC.	SETF	CLEARF	SELECT	BUF.ADDR.	STROBE I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0
32	0	0	0	0	0
33	0	0	0	0	0
34	1	0	0	0	0
35	1	1	1	0	0
36	1	1	1	1	0
37	1	1	1	3	0
38	1	1	1	2	0
39	1	1	1	5	0
40	1	1	1	4	0
41	1	0	0	0	0
42	1	0	0	0	0
43	1	0	0	0	0
44	1	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION
FILE-NAME (NORD 10): GP1:DATA
PROGRAM DESCRIPTION:

POWER PROFILE

DATA CHANNEL 1 ZERO LAG ESTIMATION $K_r = \sum_{i=0}^{N-1} (X^2_{i+(N+D-1)(r-1)} + Y^2_{i+(N+D-1)(r-1)})$

DATA CHANNEL 2 MEAN VALUE ESTIMATION $M_r = \sum_{i=0}^{N-1} (X_{i+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)})$

WHERE N=NO. OF SAMPLES IN RANGECELL
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND $\leq$0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

SINGLE PULSE

DATA CHANNEL 1

$$\mathrm{Re}\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} (X_{i+(N+D-1)(r-1)} X_{i+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

DATA CHANNEL 2

$$\mathrm{Im}\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} (X_{i+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=0,1,2,...,P P$\leq$N-1
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND $\leq$0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 - 26, 32 - 44

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION
FILE-NAME (NORD 10): GP1:DATA
PROGRAM DESCRIPTION:

CROSS CORRELATION

DATA CHANNEL 1

$$\mathrm{Re}\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+(N+D-1)(r-1)} X_{i+S+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1)}\right)$$

DATA CHANNEL 2

$$\mathrm{Im}\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+S+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1)}\right)$$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=0,1,2,...,P $P \leq N-1$
S=SAMPLE DIFFERENCE BETWEEN THE TWO SETS OF DATA
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND $\leq$0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

POWER PROFILE: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1

SINGLE PULSE: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
MINIMUM NO. OF LAGS IN RANGEDATA: 2

CROSS CORRELATION: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
MINIMUM NO. OF LAGS IN RANGEDATA: 2

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION
FILE-NAME (NORD 10): GP1:DATA
PROGRAM DESCRIPTION:

NOTES

1. This program assumes that the start addresses of the buffer and result memories are zero.
2. The number of start computes counted is placed after the last data sample in the result memory. Therefore the real and imaginary parts of this location will contain the number of start computes counted as a negative number.
3. The location for the number of start computes counted must be included in the number of 64 BIT words for the DMA transfer, ie total number samples computed+1 (for number of start computes counted).
4. The Status and Control words are transferred out before the data to the computer.
5. With the Cross Correlation program only half of the correlation function can be obtained.
6. The data, noise and calibration samples may be computed in any order, eg for a given experiment data may be computed 1st, then noise 2nd and then calibration 3rd or noise 1st, data 2nd and calibration 3rd etc.
7. All X, Y samples must be placed contiguously in the buffer memory and all samples are written contiguously in the result memory.
8. In this scheme only one routine may be chosen for a particular experiment.

HOW TO GET THE ROUTINES

POWER PROFILE: DEFINE APBRS(13)=0
SINGLE PULSE: DEFINE APBRS(11)=0
CROSS CORRELATION: DEFINE APBRS(13)≠0 AND APBRS(11)≠0

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION
FILE-NAME (NORD 10): GP1:DATA
PROGRAM DESCRIPTION:

EXECUTION TIMES FOR PROGRAMS

POWER PROFILE: $(28+2(R_1+R_2+R_3))$x0.1666667 usec N=1

$(28+(N+2)(R_1+R_2+R_3))$x0.1666667 usec $N \geq 2$

SINGLE PULSE AND CROSS CORRELATION:

$(22+(2N+(L(1-L)/2)+N(L-1)+1)(R_1+R_2+R_3))$x0.1666667 usec $N \geq 2$, $L \geq 2$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=NO. OF LAGS IN RANGECELL
R_1, R_2, R_3 =NO. OF RANGECELLS FOR DATA, NOISE AND CALIBRATION

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION
FILE-NAME (NORD 10): GP1:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF PROGRAM
DATAI REGISTER, APB	6	NO. OF 64 BIT WORDS FOR DMA TRANSFER
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION)
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 1st
APB RS(13)	16,13	NO. OF LAGS-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION)
APB RS(12)	16,12	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS)
APB RS(11)	16,11	START ADDRESS OF 2nd FIELD- START ADDRESS OF 1st FIELD
APB RS(10)	16,10	SAMPLE INCREMENT (NORMALLY=1)
APB RS(9)	16,9	TEMPORARY STORAGE
APB RS(8)	16,8	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 2nd
APB RS(7)	16,7	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 3rd
APM RS(15)	17,15	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED)
APM RS(14)	17,14	INCREMENT (=1)
APM RS(13)	17,13	TEMPORARY STORAGE
APM RS(0)	17,0	INCREMENT FOR TRANSFER PROGRAM (=1)

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION PROGRAM

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	0	0	0	0	1	18
2	56	0	4	0	0	0	0	0	0	0
3	56	0	4	0	0	0	0	0	1	19
4	56	0	4	0	0	0	0	0	0	0
5	56	0	4	0	0	0	0	0	1	20
6	56	0	10	13	0	0	0	0	0	0
7	56	0	4	0	0	0	0	0	1	19
8	56	0	10	13	0	0	0	0	0	0
9	56	0	4	0	0	0	0	0	1	19
10	56	0	10	13	0	0	0	0	0	0
11	56	0	4	0	0	0	0	0	0	0
12	56	0	6	0	0	0	0	0	0	0
13	56	0	4	0	2	0	3	2	0	0
14	60	6	4	21	0	0	0	0	0	0
15	61	6	4	20	1	0	0	1	0	0
16	61	6	4	18	1	1	0	1	0	0
17	61	4	6	17	1	0	0	1	0	0
18	56	0	4	0	3	0	0	2	0	0
19	57	4	6	16	6	0	0	1	0	0
20	58	1	6	14	2	0	1	2	0	0
21	56	0	4	0	2	0	3	0	0	0
22	57	6	4	26	1	0	0	0	0	0
23	57	6	4	25	1	0	0	0	0	0
24	57	4	6	24	1	0	0	0	0	0
25	56	0	4	0	0	0	0	0	0	0
26	58	1	6	22	2	0	1	0	0	0
32	56	0	4	0	0	0	0	0	1	20
33	56	0	4	0	0	0	0	0	0	0
34	56	0	4	0	0	0	0	0	0	0
35	56	0	4	0	0	0	0	0	0	0
36	56	0	8	0	0	0	0	2	0	0
37	56	0	4	0	0	0	0	1	0	0
38	56	0	4	0	0	0	0	0	0	0
39	56	0	4	0	0	0	0	0	0	0
40	60	0	5	0	0	0	0	0	0	0
41	56	0	4	0	0	0	0	0	0	0
42	56	0	4	0	0	0	0	0	0	0
43	56	0	4	0	0	0	0	0	0	0
44	56	1	6	0	0	0	0	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	4	0	1	15	0	0
2	7	5	1	0	0	0
3	4	0	1	14	0	0
4	7	5	1	0	0	0
5	4	0	1	13	0	0
6	7	5	0	0	0	0
7	4	0	1	8	0	0
8	0	0	0	10	0	0
9	4	0	1	7	0	0
10	0	0	0	10	0	0
11	0	0	0	10	0	0
12	7	5	1	0	0	0
13	0	1	0	12	0	0
14	0	0	0	12	0	0
15	0	0	3	11	9	0
16	1	0	3	10	9	0
17	1	0	3	10	9	0
18	0	0	0	10	0	0
19	0	0	3	11	9	0
20	7	5	1	0	0	0
21	0	1	0	12	0	0
22	0	0	0	12	0	0
23	2	0	1	0	0	0
24	0	0	0	10	0	0
25	0	0	0	10	0	0
26	7	5	1	0	0	0
32	7	0	1	0	0	0
33	7	5	1	0	0	0
34	7	5	1	0	0	0
35	7	5	1	0	0	0
36	7	5	1	0	0	0
37	7	5	1	0	0	0
38	7	5	1	0	0	0
39	7	5	1	0	0	0
40	7	5	1	0	0	0
41	7	5	1	0	0	0
42	7	5	1	0	0	0
43	7	5	1	0	0	0
44	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	7	5	1	0	0
2	7	5	1	0	0
3	7	5	1	0	0
4	7	5	1	0	0
5	7	5	1	0	0
6	7	5	0	0	0
7	7	5	1	0	0
8	0	0	0	15	0
9	7	5	1	0	0
10	0	0	0	15	0
11	0	0	0	15	0
12	7	5	1	0	0
13	0	1	0	15	0
14	7	5	1	0	0
15	0	0	0	15	0
16	0	0	3	14	13
17	1	0	3	14	13
18	7	5	1	0	0
19	2	0	1	0	0
20	7	5	1	0	0
21	7	5	1	0	0
22	0	0	0	15	0
23	7	5	1	0	0
24	7	5	1	0	0
25	2	0	1	0	0
26	7	5	1	0	0
32	7	5	1	0	0
33	7	5	1	0	0
34	7	5	1	0	0
35	7	5	0	0	0
36	0	1	0	0	0
37	0	0	0	0	0
38	2	0	1	0	0
39	2	0	1	0	0
40	2	0	1	0	0
41	7	5	1	0	0
42	7	5	1	0	0
43	7	5	1	0	0
44	7	5	1	0	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	0	0	0	0	0	0	0	0	0	0	15	15
3	0	0	0	0	0	0	0	0	0	0	0	0	15	15
4	0	0	0	0	0	0	0	0	0	0	0	0	15	15
5	0	0	0	0	0	0	0	0	0	0	0	0	15	15
6	0	0	0	0	0	0	0	0	0	0	0	0	15	15
7	0	0	0	0	0	0	0	0	0	0	0	0	15	15
8	0	0	0	0	0	0	0	0	0	0	0	0	15	15
9	0	0	0	0	0	0	0	0	0	0	0	0	15	15
10	0	0	0	0	0	0	0	0	0	0	0	0	15	15
11	0	0	0	0	0	0	0	0	0	0	0	0	12	12
12	0	0	0	0	0	0	0	0	0	0	0	0	15	15
13	0	0	0	0	0	0	0	0	0	0	0	0	15	15
14	0	0	1	1	1	0	0	1	1	1	1	1	9	6
15	0	0	1	1	1	0	0	1	2	2	2	2	9	6
16	0	0	1	1	1	0	0	1	2	2	2	2	9	6
17	0	0	1	1	1	0	0	1	2	2	2	2	9	6
18	0	0	1	1	1	0	0	1	1	1	1	1	9	6
19	0	0	1	1	1	0	0	1	2	2	2	2	9	6
20	0	0	0	0	0	0	0	0	0	0	0	0	15	15
21	0	0	0	0	0	0	0	0	0	0	0	0	15	15
22	0	0	1	1	4	0	4	1	3	3	3	3	9	9
23	0	0	0	0	0	0	0	0	3	3	3	3	6	6
24	0	0	1	1	4	0	4	1	3	3	3	3	9	9
25	0	0	1	1	4	0	4	1	3	3	3	3	9	9
26	0	0	0	0	0	0	0	0	0	0	0	0	15	15
32	0	0	0	0	0	0	0	0	0	0	0	0	15	15
33	0	0	0	0	0	0	0	0	0	0	0	0	15	15
34	0	0	0	0	0	0	0	0	0	0	0	0	15	15
35	0	0	0	0	0	0	0	0	0	0	0	0	15	15
36	0	0	0	0	0	0	0	0	0	0	0	0	15	15
37	0	0	0	0	0	0	0	0	0	0	0	0	15	15
38	0	0	0	0	0	0	0	0	0	0	0	0	15	15
39	0	0	0	0	0	0	0	0	0	0	0	0	15	15
40	0	0	0	0	0	0	0	0	0	0	0	0	15	15
41	0	0	0	0	0	0	0	0	0	0	0	0	15	15
42	0	0	0	0	0	0	0	0	0	0	0	0	15	15
43	0	0	0	0	0	0	0	0	0	0	0	0	15	15
44	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	1	0	0	0	0	0	0
3	1	0	0	0	0	0	0
4	1	0	0	0	0	0	0
5	1	0	0	0	0	0	0
6	1	0	0	0	0	0	0
7	1	0	0	0	0	0	0
8	1	0	0	0	0	0	0
9	1	0	0	0	0	0	0
10	1	0	0	0	0	0	0
11	1	1	1	1	0	0	0
12	1	0	0	0	0	0	1
13	1	0	0	1	0	0	0
14	1	0	0	0	0	0	0
15	1	1	1	1	0	0	0
16	1	1	1	0	0	0	0
17	1	1	1	0	0	0	0
18	1	0	0	0	0	0	0
19	1	1	1	0	1	0	0
20	1	0	0	0	0	0	0
21	1	0	0	1	0	0	0
22	1	1	1	0	0	0	0
23	1	0	0	0	0	0	0
24	1	0	0	0	0	0	0
25	1	1	0	0	0	0	0
26	1	1	0	0	0	0	0
32	0	0	0	0	0	1	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0

	I/O INSTRUCTIONS DEFINED						
MEM-LOC.	SETF	CLEARF	SELECT	BUF.ADDR.	STROBE	I-REG.	ENABLE EDB	ENABLE EA
0	0	0	0	0	0	0	
1	0	0	0	0	0	0	
2	0	0	0	0	0	0	
3	0	0	0	0	0	0	
4	0	0	0	0	0	0	
5	0	0	0	0	0	0	
6	0	0	0	0	0	0	
7	0	0	0	0	0	0	
8	0	0	0	0	0	0	
9	0	0	0	0	0	0	
10	0	0	0	0	0	0	
11	0	0	0	0	0	0	
12	0	0	0	0	0	0	
13	0	0	0	0	0	0	
14	0	0	0	0	0	0	
15	0	0	0	0	0	0	
16	0	0	0	0	0	0	
17	0	0	0	0	0	0	
18	0	0	0	0	0	0	
19	0	0	0	0	0	0	
20	0	0	0	0	0	0	
21	0	0	0	0	0	0	
22	0	0	0	0	0	0	
23	0	0	0	0	0	0	
24	0	0	0	0	0	0	
25	0	0	0	0	0	0	
26	0	0	0	0	0	0	
32	0	0	0	0	0	0	
33	0	0	0	0	0	0	
34	0	0	0	0	0	0	
35	0	0	0	0	0	0	
36	0	0	0	0	0	0	
37	0	0	0	0	0	0	
38	0	0	0	0	0	0	
39	0	0	0	0	0	0	
40	0	0	0	0	0	0	
41	0	0	0	0	0	0	
42	0	0	0	0	0	0	
43	0	0	0	0	0	0	
44	0	0	0	0	0	0	

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT	CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0
25	0	0	0	0	0	0
26	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	0
34	1	0	0	0	0	0
35	1	1	1	1	0	0
36	1	1	1	1	1	0
37	1	1	1	1	3	0
38	1	1	1	1	2	0
39	1	1	1	1	5	0
40	1	1	1	1	4	0
41	1	0	0	0	0	0
42	1	0	0	0	0	0
43	1	0	0	0	0	0
44	1	0	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION
FILE-NAME (NORD 10): GP2:DATA
PROGRAM DESCRIPTION:

POWER PROFILE

DATA CHANNEL 1 ZERO LAG ESTIMATION $K_r = \sum_{i=0}^{N-1} (X^2_{i+(N+D-1)(r-1)} + Y^2_{i+(N+D-1)(r-1)})$

DATA CHANNEL 2 MEAN VALUE ESTIMATION $M_r = \sum_{i=0}^{N-1} (X_{i+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)})$

DATA CHANNEL 1 MEAN VALUE X ESTIMATION $M_{X,r} = \sum_{i=0}^{N-1} X_{i+(N+D-1)(r-i)}$

DATA CHANNEL 2 MEAN VALUE Y ESTIMATION $M_{Y,r} = \sum_{i=0}^{N-1} Y_{i+(N+D-1)(r-1)}$

WHERE N=NO. OF SAMPLES IN RANGECELL
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND≤0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

SINGLE PULSE

DATA CHANNEL 1

$$\mathrm{Re}\{K_{L,r}\} = \sum_{i=0}^{N-L-1} (X_{i+(N+D-1)(r-1)} X_{i+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

DATA CHANNEL 2

$$\mathrm{Im}\{K_{L,r}\} = \sum_{i=0}^{N-L-1} (X_{i+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=0,1,2,...,P P≤N-1
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND≤0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 -26, 32 - 44

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION
FILE-NAME (NORD 10): GP2:DATA
PROGRAM DESCRIPTION:

CROSS CORRELATION

DATA CHANNEL 1

$$Re\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+(N+D-1)(r-1)} X_{i+S+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1)}\right)$$

DATA CHANNEL 2

$$Im\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+S+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1)}\right)$$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=0,1,2,...,P $P \leq N-1$
S=SAMPLE DIFFERENCE BETWEEN THE TWO SETS OF DATA
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND $\leq$0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

POWER PROFILE: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
SINGLE PULSE: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
MINIMUM NO. OF LAGS IN RANGEDATA: 2
CROSS CORRELATION: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
MINIMUM NO. OF LAGS IN RANGEDATA: 2

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION
FILE-NAME (NORD 10): GP2:DATA
PROGRAM DESCRIPTION:

NOTES

1. This program assumes that the start addresses of the buffer and result memories are zero.
2. The number of start computes counted is placed after the last data sample in the result memory. Therefore the real and imaginary parts of this location will contain the number of start computes counted as a negative number.
3. The location for the number of start computes counted must be included in the number of 64 BIT words for the DMA transfer, ie total number of samples computed+1 (for number of start computes counted).
4. The Status and Control words are transferred out before the data to the computer.
5. For the Power Profile program in a particular rangecell the zero lag estimation K_r and M_r are computed first and the mean value estimation $M_{X,r}$ and $M_{Y,r}$ second.
6. With the Cross Correlation program only half of the correlation function can be obtained.
7. The data, noise and calibration samples may be computed in any order, eg for a given experiment data may be computed 1st, then noise 2nd and then calibration 3rd or noise 1st, data 2nd and calibration 3rd etc.
8. All X, Y samples must be placed contiguously in the buffer memory and all samples are written contiguously in the result memory.
9. In this scheme only one routine may be chosen for a particular experiment.

HOW TO GET THE ROUTINES

POWER PROFILE: DEFINE APBRS(13)=0

SINGLE PULSE: DEFINE APBRS(11)=0

CROSS CORRELATION: DEFINE APBRS(13)≠0 AND APBRS(11)≠0

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION
FILE-NAME (NORD 10): GP2:DATA
PROGRAM DESCRIPTION:

EXECUTION TIMES FOR PROGRAMS

POWER PROFILE: $(28+(2N+1)(R_1+R_2+R_3))x0.1666667$ usec $N \geq 1$

SINGLE PULSE AND CROSS CORRELATION:

$(22+(2N+(L(1-L)/2)+N(L-1)+1)(R_1+R_2+R_3))x0.1666667$ usec $N \geq 2$, $L \geq 2$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=NO. OF LAGS IN RANGECELL
R_1, R_2, R_3 =NO. OF RANGECELLS FOR DATA, NOISE AND CALIBRATION

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO

DATE: 6/8/80

PROGRAM NAME: POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION
FILE-NAME (NORD 10): GP2:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF PROGRAM
DATAI REGISTER, APB	6	NO. OF 64 BIT WORDS FOR DMA TRANSFER
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION)
APB RS(14)	16,14	NO OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 1st
APB RS(13)	16,13	NO. OF LAGS-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION)
APB RS(12)	16,12	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS)
APB RS(11)	16,11	START ADDRESS OF 2nd FIELD-START ADDRESS OF 1st FIELD
APB RS(10)	16,10	SAMPLE INCREMENT (NORMALLY=1)
APB RS(9)	16,9	TEMPORARY STORAGE
APB RS(8)	16,8	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 2nd
APB RS(7)	16,7	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 3rd
APM RS(15)	17,15	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED
APM RS(14)	17,14	INCREMENT (=1)
APM RS(13)	17,15	TEMPORARY STORAGE
APM RS(0)	17,0	INCREMENT FOR TRANSFER PROGRAM (=1)

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION PROGRAM

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	0	0	0	0	1	18
2	56	0	4	0	0	0	0	0	0	0
3	56	0	4	0	0	0	0	0	1	19
4	56	0	4	0	0	0	0	0	0	0
5	56	0	4	0	0	0	0	0	1	20
6	56	0	10	13	0	0	0	0	0	0
7	56	0	4	0	0	0	0	0	1	19
8	56	0	10	13	0	0	0	0	0	0
9	56	0	4	0	0	0	0	0	1	19
10	56	0	10	13	0	0	0	0	0	0
11	56	0	4	0	0	0	0	0	0	0
12	56	0	6	0	0	0	0	0	0	0
13	56	0	4	0	2	0	3	2	0	0
14	60	6	4	21	0	0	0	0	0	0
15	61	6	4	20	1	0	0	1	0	0
16	61	6	4	18	1	1	0	1	0	0
17	61	4	6	17	1	0	0	1	0	0
18	56	0	4	0	3	0	0	2	0	0
19	57	4	6	16	6	0	0	1	0	0
20	58	1	6	14	2	0	1	2	0	0
21	56	0	4	0	2	0	3	0	0	0
22	56	0	4	0	0	0	0	0	0	0
23	57	6	4	26	1	0	0	0	0	0
24	56	0	4	0	0	0	0	0	0	0
25	57	4	6	24	1	0	0	0	0	0
26	58	1	6	22	2	0	1	0	0	0
32	56	0	4	0	0	0	0	0	1	20
33	56	0	4	0	0	0	0	0	0	0
34	56	0	4	0	0	0	0	0	0	0
35	56	0	4	0	0	0	0	0	0	0
36	56	0	8	0	0	0	0	2	0	0
37	56	0	4	0	0	0	0	1	0	0
38	56	0	4	0	0	0	0	0	0	0
39	56	0	4	0	0	0	0	0	0	0
40	60	0	5	0	0	0	0	0	0	0
41	56	0	4	0	0	1	0	0	0	0
42	56	0	4	0	0	0	0	0	0	0
43	56	0	4	0	0	0	0	0	0	0
44	56	0	0	0	0	0	0	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	4	0	1	15	0	0
2	7	5	1	0	0	0
3	4	0	1	14	0	0
4	7	5	1	0	0	0
5	4	0	1	13	0	0
6	7	5	0	0	0	0
7	4	0	1	8	0	0
8	0	0	0	10	0	0
9	4	0	1	7	0	0
10	0	0	0	10	0	0
11	0	0	0	10	0	0
12	7	5	1	0	0	0
13	0	1	0	12	0	0
14	0	0	0	12	0	0
15	0	0	3	11	9	0
16	1	0	3	10	9	0
17	1	0	3	10	9	0
18	0	0	0	10	0	0
19	0	0	3	11	9	0
20	7	5	1	0	0	0
21	0	1	0	12	0	0
22	0	0	0	12	0	0
23	2	0	1	0	0	0
24	0	0	0	10	0	0
25	2	0	1	0	0	0
26	7	5	1	0	0	0
32	7	0	1	0	0	0
33	7	5	1	0	0	0
34	7	5	1	0	0	0
35	7	5	1	0	0	0
36	7	5	1	0	0	0
37	7	5	1	0	0	0
38	7	5	1	0	0	0
39	7	5	1	0	0	0
40	7	5	1	0	0	0
41	7	5	1	0	0	0
42	7	5	1	0	0	0
43	7	5	1	0	0	0
44	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	7	5	1	0	0
2	7	5	1	0	0
3	7	5	1	0	0
4	7	5	1	0	0
5	7	5	1	0	0
6	7	5	0	0	0
7	7	5	1	0	0
8	0	0	0	15	0
9	7	5	1	0	0
10	0	0	0	15	0
11	0	0	0	15	0
12	7	5	1	0	0
13	0	1	0	15	0
14	7	5	1	0	0
15	0	0	0	15	0
16	0	0	3	14	13
17	1	0	3	14	13
18	7	5	1	0	0
19	2	0	1	0	0
20	7	5	1	0	0
21	7	5	1	0	0
22	0	0	0	15	0
23	0	0	1	15	0
24	2	0	1	0	0
25	0	0	1	15	0
26	0	0	0	15	0
32	7	5	1	0	0
33	7	5	1	0	0
34	7	5	1	0	0
35	7	5	0	0	0
36	0	1	0	0	0
37	0	0	0	0	0
38	2	0	1	0	0
39	2	0	1	0	0
40	2	0	1	0	0
41	7	5	1	0	0
42	7	5	1	0	0
43	7	5	1	0	0
44	7	5	1	0	0

	ARITHMETICAL INSTRUCTIONS DEFINED													
MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	0	0	0	0	0	0	0	0	0	0	15	15
3	0	0	0	0	0	0	0	0	0	0	0	0	15	15
4	0	0	0	0	0	0	0	0	0	0	0	0	15	15
5	0	0	0	0	0	0	0	0	0	0	0	0	15	15
6	0	0	0	0	0	0	0	0	0	0	0	0	15	15
7	0	0	0	0	0	0	0	0	0	0	0	0	15	15
8	0	0	0	0	0	0	0	0	0	0	0	0	15	15
9	0	0	0	0	0	0	0	0	0	0	0	0	15	15
10	0	0	0	0	0	0	0	0	0	0	0	0	15	15
11	0	0	0	0	0	0	0	0	0	0	0	0	12	12
12	0	0	0	0	0	0	0	0	0	0	0	0	15	15
13	0	0	0	0	0	0	0	0	0	0	0	0	15	15
14	0	0	1	1	1	0	0	1	1	1	1	1	9	6
15	0	0	1	1	1	0	0	1	2	2	2	2	9	6
16	0	0	1	1	1	0	0	1	2	2	2	2	9	6
17	0	0	1	1	1	0	0	1	2	2	2	2	9	6
18	0	0	1	1	1	0	0	1	1	1	1	1	9	6
19	0	0	1	1	1	0	0	1	2	2	2	2	9	6
20	0	0	0	0	0	0	0	0	0	0	0	0	15	15
21	0	0	0	0	0	0	0	0	0	0	0	0	15	15
22	0	0	1	1	4	0	4	1	3	3	3	3	9	9
23	4	0	4	0	4	1	4	1	3	3	3	3	15	15
24	0	0	1	1	4	0	4	1	3	3	3	3	9	9
25	4	0	4	0	4	1	4	1	3	3	3	3	15	15
26	0	0	0	0	0	0	0	0	0	0	0	0	15	15
32	0	0	0	0	0	0	0	0	0	0	0	0	15	15
33	0	0	0	0	0	0	0	0	0	0	0	0	15	15
34	0	0	0	0	0	0	0	0	0	0	0	0	15	15
35	0	0	0	0	0	0	0	0	0	0	0	0	15	15
36	0	0	0	0	0	0	0	0	0	0	0	0	15	15
37	0	0	0	0	0	0	0	0	0	0	0	0	15	15
38	0	0	0	0	0	0	0	0	0	0	0	0	15	15
39	0	0	0	0	0	0	0	0	0	0	0	0	15	15
40	0	0	0	0	0	0	0	0	0	0	0	0	15	15
41	0	0	0	0	0	0	0	0	0	0	0	0	15	15
42	0	0	0	0	0	0	0	0	0	0	0	0	15	15
43	0	0	0	0	0	0	0	0	0	0	0	0	15	15
44	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	1	0	0	0	0	0	0
3	1	0	0	0	0	0	0
4	1	0	0	0	0	0	0
5	1	0	0	0	0	0	0
6	1	0	0	0	0	0	0
7	1	0	0	0	0	0	0
8	1	0	0	0	0	0	0
9	1	0	0	0	0	0	0
10	1	0	0	0	0	0	0
11	1	1	1	1	0	0	0
12	1	0	0	0	0	0	1
13	1	0	0	1	0	0	0
14	1	0	0	0	0	0	0
15	1	1	1	1	0	0	0
16	1	1	1	0	0	0	0
17	1	1	1	0	0	0	0
18	1	0	0	0	0	0	0
19	1	1	1	0	1	0	0
20	1	0	0	0	0	0	0
21	1	0	0	1	0	0	0
22	1	1	1	1	0	0	0
23	1	1	1	0	0	0	0
24	1	1	1	0	1	0	0
25	1	1	1	0	0	0	0
26	1	0	0	0	0	0	0
32	0	0	0	0	0	1	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0

	I/O INSTRUCTIONS DEFINED						
MEM-LOC.	SETF	CLEARF	SELECT	BUF.ADDR.	STROBE	I-REG. ENABLE	EDB ENABLE	EAB
0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT	CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0
25	0	0	0	0	0	0
26	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	0
34	1	0	0	0	0	0
35	1	1	1	1	0	0
36	1	1	1	1	1	0
37	1	1	1	1	3	0
38	1	1	1	1	2	0
39	1	1	1	1	5	0
40	1	1	1	1	4	0
41	1	0	0	0	0	0
42	1	0	0	0	0	0
43	1	0	0	0	0	0
44	1	0	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: MULTI PULSE
FILE-NAME (NORD 10): GP4:DATA
PROGRAM DESCRIPTION:

DATA CHANNEL 1 $\mathrm{Re}\left\{K_{L,r}\right\} = X_{S+r-1}X_{S+L+r-1} + Y_{S+r-1}Y_{S+L+r-1}$

DATA CHANNEL 2 $\mathrm{Im}\left\{K_{L,r}\right\} = X_{S+L+r-1}Y_{S+r-1} - X_{S+r-1}Y_{S+L+r-1}$

LET J_0=POSITION OF 1st PULSE
J_1=SAMPLE DIFFERENCE BETWEEN 1st AND 2nd PULSE
.
.
J_{N-1}=SAMPLE DISTANCE BETWEEN 1st AND Nth PULSE

WHERE $S=J_0,J_1,J_2,\ldots,J_{N-2}$

$L=J_1-S,J_2-S,\ldots,J_{N-1}-S$ WITH THE RESTRICTION $L>0$

$r=1,2,\ldots,M$ RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

MINIMUM NO. OF ELEMENT PULSES IN PULSE GROUP: 2
MAXIMUM NO. OF ELEMENT PULSES IN PULSE GROUP: 11

NOTES

1. This program assumes that the start addresses of the buffer and result memories are zero.
2. The number of start computes counted is placed after the last data sample in the result memory. therefore the real and imaginary parts of this location will contain the number of start computes as a negative number.

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 - 16, 32 - 44

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: MULTI PULSE
FILE-NAME (NORD 10): GP4:DATA
PROGRAM DESCRIPTION:

NOTES (CONTINUED)

3. The location for the number of start computes counted must be included in the number of 64 BIT words for the DMA transfer, ie total number of samples computed+1 (for number of start computes counted).
4. The Status and Control words are transferred out before the data to the computer.
5. The zero lag is not computed in this algorithm, therefore to calculate the number of lags computed use the formula: N(N-1)/2 where N is the number of element pulses in pulse group.
6. The data,noise and calibration samples may be computed in any order, eg for a given experiment data may be computed 1st, then noise 2nd and then calibration 3rd or noise 1st, data 2nd and calibration 3rd etc.
7. All X, Y samples must be placed contiguously in the buffer memory and all samples are written contiguously in the result memory.

EXECUTION TIME FOR PROGRAM

$$(20+(N(N+1)/2+1)(R_1+R_2+R_3))\times 0.1666667 \text{ usec} \quad N\geq 2$$

WHERE N=NO. OF PULSES IN PULSE GROUP
R_1, R_2, R_3 =NO. OF RANGECELLS FOR DATA, NOISE AND CALIBRATION

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO

DATE: 6/8/80

PROGRAM NAME: GP4:DATA
FILE-NAME (NORD 10):

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF PROGRAM
DATAI REGISTER, APB	6	NO. OF 64 BIT WORDS FOR DMA TRANSFER
APB RS(15)	16,15	NO. OF PULSES-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION)
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 1st
APB RS(13)	16,13	RANGECELL INCREMENT (NORMALLY=1)
APB RS(12)	16,12	TEMPORARY STORAGE
APB RS(11)	16,11	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 2nd
APB RS(10)	16,10	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 3rd
⋮	⋮	⋮
APB RS(1)	16,1	SAMPLE DISTANCE BETWEEN 2nd LAST AND 1st PULSE
APB RS(0)	16,0	SAMPLE DISTANCE BETWEEN LAST AND 1st PULSE
APM RS(15)	17,15	INCREMENT (=1)
APM RS(0)	17,0	INCREMENT FOR TRANSFER PROGRAM (=1)

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : MULTI PULSE PROGRAM

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	0	0	0	0	1	18
2	56	0	4	0	0	0	0	0	0	0
3	56	0	4	0	0	0	0	0	1	19
4	56	0	10	11	0	0	0	0	0	0
5	56	0	4	0	0	0	0	0	1	19
6	56	0	10	11	0	0	0	0	0	0
7	56	0	4	0	0	0	0	0	1	19
8	56	0	10	11	0	0	0	0	0	0
9	56	0	4	0	0	0	0	0	0	0
10	56	0	6	0	0	0	0	0	0	0
11	56	0	4	0	2	0	3	0	0	0
12	57	6	4	16	6	0	0	0	0	0
13	57	6	4	15	7	1	0	0	0	0
14	57	4	6	14	7	0	0	0	0	0
15	57	4	6	13	6	0	0	0	0	0
16	56	1	6	12	0	0	1	0	0	0
32	56	0	4	0	0	0	0	0	1	20
33	56	0	4	0	0	0	0	0	0	0
34	56	0	4	0	0	0	0	0	0	0
35	56	0	4	0	0	0	0	0	0	0
36	56	0	3	0	0	0	0	2	0	0
37	56	0	4	0	0	0	0	1	0	0
38	56	0	4	0	0	0	0	0	0	0
39	56	0	4	0	0	0	0	0	0	0
40	60	0	5	0	0	0	0	0	0	0
41	56	0	4	0	0	0	0	0	0	0
42	56	0	4	0	0	0	0	0	0	0
43	56	0	4	0	0	0	0	0	0	0
44	56	0	6	0	0	0	0	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	4	0	1	15	0	0
2	7	5	1	0	0	0
3	4	0	1	14	0	0
4	7	5	0	0	0	0
5	4	0	1	11	0	0
6	0	0	0	13	0	0
7	4	0	1	10	0	0
8	0	0	0	13	0	0
9	0	0	0	13	0	0
10	7	5	1	0	0	0
11	0	1	3	13	12	0
12	1	0	3	13	12	0
13	1	0	1	12	0	1
14	1	0	1	12	0	1
15	1	0	0	12	0	1
16	7	5	1	0	0	0
32	7	0	1	0	0	0
33	7	5	1	0	0	0
34	7	5	1	0	0	0
35	7	5	1	0	0	0
36	7	5	1	0	0	0
37	7	5	1	0	0	0
38	7	5	1	0	0	0
39	7	5	1	0	0	0
40	7	5	1	0	0	0
41	7	5	1	0	0	0
42	7	5	1	0	0	0
43	7	5	1	0	0	0
44	7	5	1	0	0	0

APH-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	7	5	1	0	0
2	7	5	1	0	0
3	7	5	1	0	0
4	7	5	0	0	0
5	7	5	1	0	0
6	0	0	0	15	0
7	7	5	1	0	0
8	0	0	0	15	0
9	0	0	0	15	0
10	7	5	1	0	0
11	0	1	0	15	0
12	7	5	1	0	0
13	0	0	0	15	0
14	0	0	0	15	0
15	7	5	1	0	0
16	7	5	1	0	0
32	7	5	1	0	0
33	7	5	1	0	0
34	7	5	1	0	0
35	7	5	0	0	0
36	0	1	0	0	0
37	0	0	0	0	0
38	2	0	1	0	0
39	2	0	1	0	0
40	2	0	1	0	0
41	7	5	1	0	0
42	7	5	1	0	0
43	7	5	1	0	0
44	7	5	1	0	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	0	0	0	0	0	0	0	0	0	0	15	15
3	0	0	0	0	0	0	0	0	0	0	0	0	15	15
4	0	0	0	0	0	0	0	0	0	0	0	0	15	15
5	0	0	0	0	0	0	0	0	0	0	0	0	15	15
6	0	0	0	0	0	0	0	0	0	0	0	0	15	15
7	0	0	0	0	0	0	0	0	0	0	0	0	15	15
8	0	0	0	0	0	0	0	0	0	0	0	0	15	15
9	0	0	0	0	0	0	0	0	0	0	0	0	12	12
10	0	0	0	0	0	0	0	0	0	0	0	0	15	15
11	0	0	0	0	0	0	0	0	0	0	0	0	15	15
12	0	0	1	1	1	0	0	1	3	3	3	3	9	6
13	0	0	1	1	1	0	0	1	2	2	2	2	9	6
14	0	0	1	1	1	0	0	1	2	2	2	2	9	6
15	0	0	1	1	1	0	0	1	3	3	3	3	9	6
16	0	0	0	0	0	0	0	0	0	0	0	0	15	15
32	0	0	0	0	0	0	0	0	0	0	0	0	15	15
33	0	0	0	0	0	0	0	0	0	0	0	0	15	15
34	0	0	0	0	0	0	0	0	0	0	0	0	15	15
35	0	0	0	0	0	0	0	0	0	0	0	0	15	15
36	0	0	0	0	0	0	0	0	0	0	0	0	15	15
37	0	0	0	0	0	0	0	0	0	0	0	0	15	15
38	0	0	0	0	0	0	0	0	0	0	0	0	15	15
39	0	0	0	0	0	0	0	0	0	0	0	0	15	15
40	0	0	0	0	0	0	0	0	0	0	0	0	15	15
41	0	0	0	0	0	0	0	0	0	0	0	0	15	15
42	0	0	0	0	0	0	0	0	0	0	0	0	15	15
43	0	0	0	0	0	0	0	0	0	0	0	0	15	15
44	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	1	0	0	0	0	0	0
3	1	0	0	0	0	0	0
4	1	0	0	0	0	0	0
5	1	0	0	0	0	0	0
6	1	0	0	0	0	0	0
7	1	0	0	0	0	0	0
8	1	0	0	0	0	0	0
9	1	1	1	1	0	0	0
10	1	0	0	0	0	0	1
11	1	0	0	1	0	0	0
12	1	0	0	0	0	0	0
13	1	1	1	0	0	0	0
14	1	1	1	0	0	0	0
15	1	0	0	0	0	0	0
16	1	0	0	0	0	0	0
32	0	0	0	0	0	1	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	1	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0

I/O INSTRUCTIONS DEFINED

MEM-LOC.	SETF	CLEARF	SELECT	BUF.ADDR.	STROBE	I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0		0	0	0	
1	0	0	0		0	0	0	
2	0	0	0		0	0	0	
3	0	0	0		0	0	0	
4	0	0	0		0	0	0	
5	0	0	0		0	0	0	
6	0	0	0		0	0	0	
7	0	0	0		0	0	0	
8	0	0	0		0	0	0	
9	0	0	0		0	0	0	
10	0	0	0		0	0	0	
11	0	0	0		0	0	0	
12	0	0	0		0	0	0	
13	0	0	0		0	0	0	
14	0	0	0		0	0	0	
15	0	0	0		0	0	0	
16	0	0	0		0	0	0	
32	0	0	0		0	0	0	
33	0	0	0		0	0	0	
34	0	0	0		0	0	0	
35	0	0	0		0	0	0	
36	0	0	0		0	0	0	
37	0	0	0		0	0	0	
38	0	0	0		0	0	0	
39	0	0	0		0	0	0	
40	0	0	0		0	0	0	
41	0	0	0		0	0	0	
42	0	0	0		0	0	0	
43	0	0	0		0	0	0	
44	0	0	0		0	0	0	

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
32	0	0	0	0	0
33	0	0	0	0	0
34	1	0	0	0	0
35	1	1	1	0	0
36	1	1	1	1	0
37	1	1	1	3	0
38	1	1	1	2	0
39	1	1	1	5	0
40	1	1	1	4	0
41	1	0	0	0	0
42	1	0	0	0	0
43	1	0	0	0	0
44	1	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: ANY TWO FROM POWER PROFILE (VER.1), SINGLE PULSE, CROSS CORRELATION
FILE-NAME (NORD 10): GP5:DATA
PROGRAM DESCRIPTION:

POWER PROFILE

DATA CHANNEL 1 ZERO LAG ESTIMATION $K_r = \sum_{i=0}^{N-1} (X^2_{i+(N+D-1)(r-1)} + Y^2_{i+(N+D-1)(r-1)})$

DATA CHANNEL 2 MEAN VALUE ESTIMATION $M_r = \sum_{i=0}^{N-1} (X_{i+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)})$

WHERE N=NO. OF SAMPLES IN RANGECELL
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND≤0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

SINGLE PULSE

DATA CHANNEL 1

$$Re\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} (X_{i+(N+D-1)(r-1)} X_{i+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

DATA CHANNEL 2

$$Im\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} (X_{i+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=0,1,2,...,P P≤N-1
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND≤0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

START ADDRESS FOR PROGRAM: 1
PROGRAM-MEMORY LOCATIONS USED: 1 - 22, 32 - 44, 49 - 62

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: ANY TWO FROM POWER PROFILE (VER.1), SINGLE PULSE, CROSS CORRELATION
FILE-NAME (NORD 10): GP5:DATA
PROGRAM DESCRIPTION:

CROSS CORRELATION

DATA CHANNEL 1

$$\mathrm{Re}\left\{K_{L,r}\right\}=\sum_{i=0}^{N-L-1}\left(X_{i+(N+D-1)(r-1)}X_{i+S+L+(N+D-1)(r-1)}+Y_{i+(N+D-1)(r-1)}Y_{i+S+L+(N+D-1)(r-1)}\right)$$

DATA CHANNEL 2

$$\mathrm{Im}\left\{K_{L,r}\right\}=\sum_{i=0}^{N-L-1}\left(X_{i+S+L+(N+D-1)(r-1)}Y_{i+(N+D-1)(r-1)}-X_{i+(N+D-1)(r-1)}Y_{i+S+L+(N+D-1)(r-1)}\right)$$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=0,1,2,...,P P$\leqslant$N-1
S=SAMPLE DIFFERENCE BETWEEN THE TWO SETS OF DATA
D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND$\leqslant$0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

POWER PROFILE: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1

SINGLE PULSE: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
MINIMUM NO. OF LAGS IN RANGEDATA: 2

CROSS CORRELATION: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
MINIMUM NO. OF LAGS IN RANGEDATA: 2

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: ANY TWO FROM POWER PROFILE (VER.1), SINGLE PULSE, CROSS CORRELATION
FILE-NAME (NORD 10): GP5:DATA
PROGRAM DESCRIPTION:

NOTES

1. This program assumes that the start addresses of the buffer and result memories are zero.
2. The number of start computes counted is placed after the last data sample in the result memory. Therefore the real and imaginary parts of this location will contain the number of start computes counted as a negative number.
3. The location for the number of start computes counted must be included in the number of 64 BIT words for the DMA transfer, ie total number of samples computed+1 (for number of start computes counted).
4. The Status and Control words are transferred out before the data to the computer.
5. With the Cross Correlation program only half of the correlation function can be obtained.
6. As any two routines may be combined to form an experiment, the experiment must be designed such that the data, noise and calibration samples of a particular routine be computed first and the data, noise and calibration samples of the other routine second. Of course the data, noise and calibration samples in a particular routine may be computed in any order. The parameters for the first routine are indicated by PROG 1, likewise PROG 2, for the second routine in the PARAMETER field.
7. All X, Y samples must be placed contiguously in the buffer memory and all samples are written contiguously in the result memory.
8. In this scheme any two of the three routines may be combeined in any order, eg Power Profile and Cross Correlation, Cross Correlation and Single Pulse, etc.

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: ANY TWO FROM POWER PROFILE (VER.1), SINGLE PULSE, CROSS CORRELATION
FILE-NAME (NORD 10): GP5:DATA
PROGRAM DESCRIPTION:

HOW TO GET THE ROUTINES

FOR PROG 1: POWER PROFILE: DEFINE APBRS(13)=0
SINGLE PULSE: DEFINE APBRS(11)=0
CROSS CORRELATION: DEFINE APBRS(13)≠0 AND APBRS(11)≠0

FOR PROG 2: POWER PROFILE: DEFINE APBRS(4)=0
SINGLE PULSE: DEFINE APBRS(3)=0
CROSS CORRELATION: DEFINE APBRS(4)≠0 AND APBRS(3)≠0

EXECUTION TIMES FOR PROGRAMS

POWER PROFILE: $(19+2(R_1+R_2+R_3))x0.1666667$ usec N=1

$(19+(N+2)(R_1+R_2+R_3))x0.1666667$ usec $N \geq 2$

SINGLE PULSE AND CROSS CORRELATION:

$(13+(2N+(L(1-L)/2)+N(L-1)+1)(R_1+R_2+R_3))x0.1666667$ usec $N \geq 2$, $L \geq 2$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=NO. OF LAGS IN RANGECELL
R_1, R_2, R_3 =NO. OF RANGECELLS FOR DATA, NOISE AND CALIBRATION

TOTAL EXECUTION TIME = TIME(PROG 1) + TIME(PROG 2) + 1.5000003 usec

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: ANY TWO FROM POWER PROFILE (VER.1), SINGLE PULSE, CROSS CORRELATION
FILE-NAME (NORD 10): GP5:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF PROGRAM
DATAI REGISTER, APB	6	NO. OF 64 BIT WORDS FOR DMA TRANSFER
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 1
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 1st PROG 1
APB RS(13)	16,13	NO. OF LAGS-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 1
APB RS(12)	16,12	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS) PROG 1 AND PROG 2
APB RS(11)	16,11	START ADDRESS OF 2nd FIELD-START ADDRESS OF 1st FIELD PROG 1
APB RS(10)	16,10	SAMPLE INCREMENT (NORMALLY=1) PROG 1 AND PROG 2
APB RS(9)	16,9	TEMPORARY STORAGE
APB RS(8)	16,8	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 2nd PROG 1
APB RS(7)	16,7	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 3rd PROG 1
APB RS(6)	16,6	NO. OF SAMPLES-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 2
APB RS(5)	16,5	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 4th PROG 2
APB RS(4)	16,4	NO. OF LAGS-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 2
APB RS(3)	16,3	START ADDRESS OF 2nd FIELD-START ADDRESS OF 1st FIELD PROG 2
APB RS(2)	16,2	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 5th PROG 2
APB RS(1)	16,1	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 6th PROG 2

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: ANY TWO FROM POWER PROFILE (VER.1), SINGLE PULSE, CROSS CORRELATION
FILE-NAME (NORD 10): GP5:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
APB RS(0)	16,0	TEMPORARY STORAGE
APM RS(15)	17,15	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED) PROG 1
APM RS(14)	17,14	INCREMENT (=1)
APM RS(13)	17,13	TEMPORARY STORAGE
APM RS(12)	17,12	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED) PROG 2
APM RS(11)	17,11	TEMPORARY STORAGE
APM RS(0)	17,0	INCREMENT FOR TRANSFER PROGRAM (=1)

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : ANY 2 FROM POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION PROGRAMS

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	0	0	0	0	1	18
2	56	0	4	0	0	0	0	0	0	0
3	56	0	4	0	0	0	0	0	1	19
4	56	0	4	0	0	0	0	0	0	0
5	56	0	4	0	0	0	0	0	1	20
6	56	0	10	49	0	0	0	0	0	0
7	56	0	4	0	0	0	0	0	1	19
8	56	0	10	49	0	0	0	0	0	0
9	56	0	4	0	0	0	0	0	1	19
10	56	0	10	49	0	0	0	0	0	0
11	56	0	4	0	0	0	0	0	1	18
12	56	0	4	0	0	0	0	0	0	0
13	56	0	4	0	0	0	0	0	1	19
14	56	0	4	0	0	0	0	0	0	0
15	56	0	4	0	0	0	0	0	1	20
16	56	0	10	49	0	0	0	0	0	0
17	56	0	4	0	0	0	0	0	1	19
18	56	0	10	49	0	0	0	0	0	0
19	56	0	4	0	0	0	0	0	1	19
20	56	0	10	49	0	0	0	0	0	0
21	56	0	4	0	0	0	0	0	0	0
22	56	0	6	0	0	0	0	0	0	0
32	56	0	4	0	0	0	0	0	1	20
33	56	0	4	0	0	0	0	0	0	0
34	56	0	4	0	0	0	0	0	0	0
35	56	0	4	0	0	0	0	0	0	0
36	56	0	0	0	0	0	0	2	0	0
37	56	0	4	0	0	0	0	1	0	0
38	56	0	4	0	0	0	0	0	0	0
39	56	0	4	0	0	0	0	0	0	0
40	60	0	5	0	0	0	0	0	0	0
41	56	0	4	0	0	0	0	0	0	0
42	56	0	4	0	0	0	0	0	0	0
43	56	0	4	0	0	0	0	0	0	0
44	56	0	6	0	0	0	0	0	0	0
49	56	0	4	0	2	0	3	2	0	0
50	60	6	4	57	0	0	0	0	0	0
51	61	6	4	56	1	0	0	1	0	0
52	61	6	4	56	1	1	0	1	0	0
53	61	4	6	55	1	0	0	1	0	0
54	56	0	4	0	3	0	0	2	0	0
55	57	4	6	52	6	0	0	1	0	0
56	58	1	6	50	2	0	1	2	0	0
57	56	0	4	0	2	0	3	0	0	0
58	57	6	4	62	1	0	0	0	0	0
59	57	6	4	61	1	0	0	0	0	0
60	57	4	6	60	1	0	0	0	0	0
61	56	0	4	0	0	0	0	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	4	0	1	15	0	0
2	4	0	3	11	0	0
3	4	0	1	14	0	0
4	7	5	1	0	0	0
5	4	0	1	13	0	0
6	7	5	0	0	0	0
7	4	0	1	8	0	0
8	0	0	0	10	0	0
9	4	0	1	7	0	0
10	0	0	0	10	0	0
11	4	0	1	6	0	0
12	4	0	3	3	0	0
13	4	0	1	5	0	0
14	7	5	1	0	0	0
15	4	0	1	4	0	0
16	0	0	0	10	0	0
17	4	0	1	2	0	0
18	0	0	0	10	0	0
19	4	0	1	1	0	0
20	0	0	0	10	0	0
21	0	0	0	10	0	0
22	7	5	1	0	0	0
32	7	0	1	0	0	0
33	7	5	1	0	0	0
34	7	5	1	0	0	0
35	7	5	1	0	0	0
36	7	5	1	0	0	0
37	7	5	1	0	0	0
38	7	5	1	0	0	0
39	7	5	1	0	0	0
40	7	5	1	0	0	0
41	7	5	1	0	0	0
42	7	5	1	0	0	0
43	7	5	1	0	0	0
44	7	5	1	0	0	0
49	0	1	0	12	0	0
50	0	0	0	12	0	0
51	0	0	3	0	9	0
52	1	0	3	10	9	0
53	1	0	3	10	9	0
54	0	0	0	10	0	0
55	0	0	3	0	9	0
56	7	5	1	0	0	0
57	0	1	0	12	0	0
58	0	0	0	12	0	0
59	2	0	1	0	0	0
60	0	0	0	10	0	0
61	0	0	0	10	0	0
62	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	4	0	3	15	11
2	7	5	1	0	0
3	7	5	1	0	0
4	7	5	1	0	0
5	7	5	1	0	0
6	7	5	0	0	0
7	7	5	1	0	0
8	0	0	0	11	0
9	7	5	1	0	0
10	0	0	0	11	0
11	0	0	0	11	0
12	7	5	1	0	0
13	7	5	1	0	0
14	7	5	1	0	0
15	7	5	1	0	0
16	4	0	3	12	11
17	7	5	1	0	0
18	0	0	0	11	0
19	7	5	1	0	0
20	0	0	0	11	0
21	0	0	0	11	0
22	7	5	1	0	0
32	7	5	1	0	0
33	7	5	1	0	0
34	7	5	1	0	0
35	7	5	0	0	0
36	0	1	0	0	0
37	0	0	0	0	0
38	2	0	1	0	0
39	2	0	1	0	0
40	2	0	1	0	0
41	7	5	1	0	0
42	7	5	1	0	0
43	7	5	1	0	0
44	7	5	1	0	0
49	0	1	0	11	0
50	7	5	1	0	0
51	0	0	0	11	0
52	0	0	3	14	13
53	1	0	3	14	13
54	7	5	1	0	0
55	2	0	1	0	0
56	7	5	1	0	0
57	7	5	1	0	0
58	0	0	0	11	0
59	7	5	1	0	0
60	7	5	1	0	0
61	2	0	1	0	0
62	7	5	1	0	0

	ARITHMETICAL INSTRUCTIONS DEFINED													
MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	0	0	0	0	0	0	0	0	0	0	15	15
3	0	0	0	0	0	0	0	0	0	0	0	0	15	15
4	0	0	0	0	0	0	0	0	0	0	0	0	15	15
5	0	0	0	0	0	0	0	0	0	0	0	0	15	15
6	0	0	0	0	0	0	0	0	0	0	0	0	15	15
7	0	0	0	0	0	0	0	0	0	0	0	0	15	15
8	0	0	0	0	0	0	0	0	0	0	0	0	15	15
9	0	0	0	0	0	0	0	0	0	0	0	0	15	15
10	0	0	0	0	0	0	0	0	0	0	0	0	15	15
11	0	0	0	0	0	0	0	0	0	0	0	0	15	15
12	0	0	0	0	0	0	0	0	0	0	0	0	15	15
13	0	0	0	0	0	0	0	0	0	0	0	0	15	15
14	0	0	0	0	0	0	0	0	0	0	0	0	15	15
15	0	0	0	0	0	0	0	0	0	0	0	0	15	15
16	0	0	0	0	0	0	0	0	0	0	0	0	15	15
17	0	0	0	0	0	0	0	0	0	0	0	0	15	15
18	0	0	0	0	0	0	0	0	0	0	0	0	15	15
19	0	0	0	0	0	0	0	0	0	0	0	0	15	15
20	0	0	0	0	0	0	0	0	0	0	0	0	15	15
21	0	0	0	0	0	0	0	0	0	0	0	0	12	12
22	0	0	0	0	0	0	0	0	0	0	0	0	15	15
32	0	0	0	0	0	0	0	0	0	0	0	0	15	15
33	0	0	0	0	0	0	0	0	0	0	0	0	15	15
34	0	0	0	0	0	0	0	0	0	0	0	0	15	15
35	0	0	0	0	0	0	0	0	0	0	0	0	15	15
36	0	0	0	0	0	0	0	0	0	0	0	0	15	15
37	0	0	0	0	0	0	0	0	0	0	0	0	15	15
38	0	0	0	0	0	0	0	0	0	0	0	0	15	15
39	0	0	0	0	0	0	0	0	0	0	0	0	15	15
40	0	0	0	0	0	0	0	0	0	0	0	0	15	15
41	0	0	0	0	0	0	0	0	0	0	0	0	15	15
42	0	0	0	0	0	0	0	0	0	0	0	0	15	15
43	0	0	0	0	0	0	0	0	0	0	0	0	15	15
44	0	0	0	0	0	0	0	0	0	0	0	0	15	15
49	0	0	0	0	0	0	0	0	0	0	0	0	15	15
50	0	0	1	1	1	0	0	1	1	1	1	1	9	6
51	0	0	1	1	1	0	0	1	2	2	2	2	9	6
52	0	0	1	1	1	0	0	1	2	2	2	2	9	6
53	0	0	1	1	1	0	0	1	2	2	2	2	9	6
54	0	0	1	1	1	0	0	1	1	1	1	1	9	6
55	0	0	1	1	1	0	0	1	2	2	2	2	9	6
56	0	0	0	0	0	0	0	0	0	0	0	0	15	15
57	0	0	0	0	0	0	0	0	0	0	0	0	15	15
58	0	0	1	1	4	0	4	1	3	3	3	3	9	9
59	0	0	0	0	0	0	0	0	3	3	3	3	6	6
60	0	0	1	1	4	0	4	1	3	3	3	3	9	9
61	0	0	1	1	4	0	4	1	3	3	3	3	9	9
62	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	1	0	0	0	0	0	0
3	1	0	0	0	0	0	0
4	1	0	0	0	0	0	0
5	1	0	0	0	0	0	0
6	1	0	0	0	0	0	0
7	1	0	0	0	0	0	0
8	1	0	0	0	0	0	0
9	1	0	0	0	0	0	0
10	1	0	0	0	0	0	0
11	1	0	0	0	0	0	0
12	1	0	0	0	0	0	0
13	1	0	0	0	0	0	0
14	1	0	0	0	0	0	0
15	1	0	0	0	0	0	0
16	1	0	0	0	0	0	0
17	1	0	0	0	0	0	0
18	1	0	0	0	0	0	0
19	1	0	0	0	0	0	0
20	1	0	0	0	0	0	0
21	1	1	1	1	0	0	0
22	1	0	0	0	0	0	1
32	0	0	0	0	0	1	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0
49	1	0	0	1	0	0	0
50	1	0	0	0	0	0	0
51	1	1	1	1	0	0	0
52	1	1	1	0	0	0	0
53	1	1	1	0	0	0	0
54	1	0	0	0	0	0	0
55	1	1	1	0	1	0	0
56	1	0	0	0	0	0	0
57	1	0	0	1	0	0	0
58	1	1	1	0	0	0	0
59	1	0	0	0	0	0	0
60	1	0	0	0	0	0	0
61	1	1	0	0	0	0	0
62	1	0	0	0	0	0	0

	I/O INSTRUCTIONS DEFINED						
MEM-LOC.	SETF	CLEARF	SELECT	BUF.ADDR.	STROBE	I-REG. ENABLE	EDB ENABLE EAB
0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT	CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	0
34	1	0	0	0	0	0
35	1	1	1	0	0	0
36	1	1	1	1	0	0
37	1	1	1	3	0	0
38	1	1	1	2	0	0
39	1	1	1	5	0	0
40	1	1	1	4	0	0
41	1	0	0	0	0	0
42	1	0	0	0	0	0
43	1	0	0	0	0	0
44	1	0	0	0	0	0
49	0	0	0	0	0	0
50	0	0	0	0	0	0
51	0	0	0	0	0	0
52	0	0	0	0	0	0
53	0	0	0	0	0	0
54	0	0	0	0	0	0
55	0	0	0	0	0	0
56	0	0	0	0	0	0
57	0	0	0	0	0	0
58	0	0	0	0	0	0
59	0	0	0	0	0	0
60	0	0	0	0	0	0
61	0	0	0	0	0	0
62	0	0	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: ANY TWO FROM POWER PROFILE (VER.2), SINGLE PULSE, CROSS CORRELATION

FILE-NAME (NORD 10): GP6:DATA

PROGRAM DESCRIPTION:

POWER PROFILE

DATA CHANNEL 1 ZERO LAG ESTIMATION $K_r = \sum_{i=0}^{N-1} (X^2_{i+(N+D-1)(r-1)} + Y^2_{i+(N+D-1)(r-1)})$

DATA CHANNEL 2 MEAN VALUE ESTIMATION $M_r = \sum_{i=0}^{N-1} (X_{i+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)})$

DATA CHANNEL 1 MEAN VALUE X ESTIMATION $M_{X,r} = \sum_{i=0}^{N-1} X_{i+(N+D-1)(r-1)}$

DATA CHANNEL 2 MEAN VALUE Y ESTIMATION $M_{Y,r} = \sum_{i=0}^{N-1} Y_{i+(N+D-1)(r-1)}$

WHERE N=NO. OF SAMPLES IN RANGECELL

D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND $\leq$0 FOR OVERLAPPING)

r=1,2,...,M RANGECELLS FOR TIME AVERAGE

SINGLE PULSE

DATA CHANNEL 1

$$\mathrm{Re}\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} (X_{i+(N+D-1)(r-1)} X_{i+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

DATA CHANNEL 2

$$\mathrm{Im}\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} (X_{i+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

WHERE N=NO. OF SAMPLES IN RANGECELL

L=0,1,2,...,P P$\leq$N-1

D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND $\leq$0 FOR OVERLAPPING)

r=1,2,...,M RANGECELLS FOR TIME AVERAGE

START ADDRESS FOR PROGRAM: 1

PROGRAM-MEMORY LOCATIONS USED: 1 - 26, 32 - 44, 49 - 62

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: ANY TWO FROM POWER PROFILE (VER.2), SINGLE PULSE, CROSS CORRELATION
FILE-NAME (NORD 10): GP6:DATA
PROGRAM DESCRIPTION:

CROSS CORRELATION

DATA CHANNEL 1

$$\mathrm{Re}\left\{K_{L,r}\right\}=\sum_{i=0}^{N-L-1}\left(X_{i+(N+D-1)(r-1)}X_{i+S+L+(N+D-1)(r-1)}+Y_{i+(N+D-1)(r-1)}Y_{i+S+L+(N+D-1)(r-1)}\right)$$

DATA CHANNEL 2

$$\mathrm{Im}\left\{K_{L,r}\right\}=\sum_{i=0}^{N-L-1}\left(X_{i+S+L+(N+D-1)(r-1)}Y_{i+(N+D-1)(r-1)}-X_{i+(N+D-1)(r-1)}Y_{i+S+L+(N+D-1)(r-1)}\right)$$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=0,1,2,...,P P$\leqslant$N-1
S=SAMPLE DIFFERENCE BETWEEN THE TWO SETS OF DATA
D= OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND$\leqslant$0 FOR OVERLAPPING)
r=1,2,...,M RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

POWER PROFILE: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1

SINGLE PULSE: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
MINIMUM NO. OF LAGS IN RANGEDATA: 2

CROSS CORRELATION: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
MINIMUM NO. OF LAGS IN RANGEDATA: 2

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: ANY TWO FROM POWER PROFILE (VER.2), SINGLE PULSE, CROSS CORRELATION

FILE-NAME (NORD 10): GP6:DATA

PROGRAM DESCRIPTION:

NOTES

1. This program assumes that the start addresses of the buffer and result memories are zero.
2. The number of start computes counted is placed after the last data sample in the result memory. Therefore the real and imaginary parts of this location will contain the number of start computes counted as a negative number.
3. The location for the number of start computes counted must be included in the number of 64 BIT words for the DMA transfer, ie total number of samples computed+1 (for number of start computes counted).
4. The Status and Control words are transferred out before the data to the computer.
5. For the Power Profile program in a particular rangecell the zero lag estimation K_r and M_r are computed first and the mean value estimation $M_{X,r}$ and $M_{Y,r}$ second.
6. With the Cross Correlation program only half of the correlation function can be obtained.
7. As any two routines may be combined to form an experiment, the experiment must be designed such that the data, noise and calibration samples of a particular routine be computed first and the data, noise and calibration samples of the other routine second. Of course the data, noise and calibration samples in a particular routine may be computed in any order. The parameters for the first routine are indicated by PROG 1, likewise PROG 2, for the second routine in the PARAMETER field.
8. All X, Y samples must be placed contiguously in the buffer memory and all samples are written contiguously in the result memory.
9. In this scheme any two of the three routines may be combined in any order, eg Power Profile and Cross Correlation, Cross Correlation and Single Pulse, etc.

START ADDRESS FOR PROGRAM:

PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: ANY TWO FROM POWER PROFILE (VER.2), SINGLE PULSE, CROSS CORRELATION
FILE-NAME (NORD 10): GP6:DATA
PROGRAM DESCRIPTION:

HOW TO GET THE ROUTINES

FOR PROG 1: POWER PROFILE: DEFINE APBRS(13)=0
SINGLE PULSE: DEFINE APBRS(11)=0
CROSS CORRELATION: DEFINE APBRS(13)≠0 AND APBRS(11)≠0

FOR PROG 2: POWER PROFILE: DEFINE APBRS(4)=0
SINGLE PULSE: DEFINE APBRS(3)=0
CROSS CORRELATION: DEFINE APBRS(4)≠0 AND APBRS(3)≠0

EXECUTION TIMES FOR PROGRAMS

POWER PROFILE: $(19+(2N+1)(R_1+R_2+R_3))\times 0.1666667$ usec $N \geq 1$

SINGLE PULSE AND CROSS CORRELATION:

$(13+(2N+(L(1-L)/2)+N(L-1)+1)(R_1+R_2+R_3))\times 0.1666667$ usec $N \geq 2$, $L \geq 2$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=NO. OF LAGS IN RANGECELL
R_1, R_2, R_3 =NO. OF RANGECELLS FOR DATA, NOISE AND CALIBRATION

TOTAL EXECUTION TIME = TIME(PROG 1) + TIME(PROG 2) + 1.5000003 usec

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: ANY TWO FROM POWER PROFILE (VER.2), SINGLE PULSE, CROSS CORRELATION
FILE-NAME (NORD 10): GP6:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF PROGRAM
DATAI REGISTER, APB	6	NO. OF 64 BIT WORDS FOR DMA TRANSFER
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 1
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 1st PROG 1
APB RS(13)	16,13	NO. OF LAGS-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 1
APB RS(12)	16,12	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS) PROG 1 AND PROG 2
APB RS(11)	16,11	START ADDRESS OF 2nd FIELD-START ADDRESS OF 1st FIELD PROG 1
APB RS(10)	16,10	SAMPLE INCREMENT (NORMALLY=1) PROG 1 AND PROG 2
APB RS(9)	16,9	TEMPORARY STORAGE
APB RS(8)	16,8	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 2nd PROG 1
APB RS(7)	16,7	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 3rd PROG 1
APB RS(6)	16,6	NO. OF SAMPLES-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 2
APB RS(5)	16,5	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 4th PROG 2
APB RS(4)	16,4	NO. OF LAGS-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 2
APB RS(3)	16,3	START ADDRESS OF 2nd FIELD-START ADDRESS OF 1st FIELD PROG 2
APB RS(2)	16,2	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 5th PROG 2
APB RS(1)	16,1	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 6th PROG 2

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: ANY TWO FROM POWER PROFILE (VER.2), SINGLE PULSE, CROSS CORRELATION
FILE-NAME (NORD 10): GP6:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
APB RS(0)	16,0	TEMPORARY STORAGE
APM RS(15)	17,15	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED) PROG 1
APM RS(14)	17,14	INCREMENT (=1)
APM RS(13)	17,13	TEMPORARY STORAGE
APM RS(12)	17,12	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED) PROG 2
APM RS(11)	17,11	TEMPORARY STORAGE
APM RS(0)	17,0	INCREMENT FOR TRANSFER PROGRAM (=1)

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : ANY 2 FROM POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION PROGRAMS

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	0	0	0	0	1	18
2	56	0	4	0	0	0	0	0	0	0
3	56	0	4	0	0	0	0	0	1	19
4	56	0	4	0	0	0	0	0	0	0
5	56	0	4	0	0	0	0	0	1	20
6	56	0	10	49	0	0	0	0	0	0
7	56	0	4	0	0	0	0	0	1	19
8	56	0	10	49	0	0	0	0	0	0
9	56	0	4	0	0	0	0	0	1	19
10	56	0	10	49	0	0	0	0	0	0
11	56	0	4	0	0	0	0	0	1	18
12	56	0	4	0	0	0	0	0	0	0
13	56	0	4	0	0	0	0	0	1	19
14	56	0	4	0	0	0	0	0	0	0
15	56	0	4	0	0	0	0	0	1	20
16	56	0	10	49	0	0	0	0	0	0
17	56	0	4	0	0	0	0	0	1	19
18	56	0	10	49	0	0	0	0	0	0
19	56	0	4	0	0	0	0	0	1	19
20	56	0	10	49	0	0	0	0	0	0
21	56	0	4	0	0	0	0	0	0	0
22	56	0	6	0	0	0	0	0	0	0
32	56	0	4	0	0	0	0	0	1	20
33	56	0	4	0	0	0	0	0	0	0
34	56	0	4	0	0	0	0	0	0	0
35	56	0	4	0	0	0	0	0	0	0
36	56	0	6	0	0	0	0	2	0	0
37	56	0	4	0	0	0	0	1	0	0
38	56	0	4	0	0	0	0	0	0	0
39	56	0	4	0	0	0	0	0	0	0
40	60	0	5	0	0	0	0	0	0	0
41	56	0	4	0	0	0	0	0	0	0
42	56	0	4	0	0	0	0	0	0	0
43	56	0	4	0	0	0	0	0	0	0
44	56	0	6	0	0	0	0	0	0	0
49	56	0	4	0	2	0	3	2	0	0
50	60	6	4	57	0	0	0	0	0	0
51	61	6	4	56	1	0	0	1	0	0
52	61	6	4	54	1	1	0	1	0	0
53	61	4	6	53	1	1	0	1	0	0
54	56	0	4	1	3	0	0	2	0	0
55	57	4	6	52	6	0	0	1	0	0
56	56	1	6	50	2	1	1	2	0	0
57	56	0	4	0	2	0	3	0	0	0
58	56	0	4	1	0	0	3	0	0	0
59	57	6	4	52	1	1	0	0	0	0
60	56	0	4	0	0	0	0	0	0	0
61	57	4	6	54	1	0	1	1	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	4	0	1	15	0	0
2	4	0	3	11	0	0
3	4	0	1	14	0	0
4	7	5	1	0	0	0
5	4	0	1	13	0	0
6	7	5	0	0	0	0
7	4	0	1	8	0	0
8	0	0	0	10	0	0
9	4	0	1	7	0	0
10	0	0	0	10	0	0
11	4	0	1	6	0	0
12	4	0	3	3	0	0
13	4	0	1	5	0	0
14	7	5	1	0	0	0
15	4	0	1	4	0	0
16	0	0	0	10	0	0
17	4	0	1	2	0	0
18	0	0	0	10	0	0
19	4	0	1	1	0	0
20	0	0	0	10	0	0
21	0	0	0	10	0	0
22	7	5	1	0	0	0
32	7	0	1	0	0	0
33	7	5	1	0	0	0
34	7	5	1	0	0	0
35	7	5	1	0	0	0
36	7	5	1	0	0	0
37	7	5	1	0	0	0
38	7	5	1	0	0	0
39	7	5	1	0	0	0
40	7	5	1	0	0	0
41	7	5	1	0	0	0
42	7	5	1	0	0	0
43	7	5	1	0	0	0
44	7	5	1	0	0	0
49	0	1	0	12	0	0
50	0	0	0	12	0	0
51	0	0	3	0	9	0
52	1	0	3	10	9	0
53	1	0	3	10	9	0
54	0	0	0	10	0	0
55	0	0	3	0	9	0
56	7	5	1	0	0	0
57	0	1	0	12	0	0
58	0	0	0	12	0	0
59	2	0	1	0	0	0
60	0	0	0	10	0	0
61	2	0	1	0	0	0
62	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	4	0	3	15	11
2	7	5	1	0	0
3	7	5	1	0	0
4	7	5	1	0	0
5	7	5	1	0	0
6	7	5	0	0	0
7	7	5	1	0	0
8	0	0	0	11	0
9	7	5	1	0	0
10	0	0	0	11	0
11	0	0	0	11	0
12	7	5	1	0	0
13	7	5	1	0	0
14	7	5	1	0	0
15	7	5	1	0	0
16	4	0	3	12	11
17	7	5	1	0	0
18	0	0	0	11	0
19	7	5	1	0	0
20	0	0	0	11	0
21	0	0	0	11	0
22	7	5	1	0	0
32	7	5	1	0	0
33	7	5	1	0	0
34	7	5	1	0	0
35	7	5	0	0	0
36	0	1	0	0	0
37	0	0	0	0	0
38	2	0	1	0	0
39	2	0	1	0	0
40	2	0	1	0	0
41	7	5	1	0	0
42	7	5	1	0	0
43	7	5	1	0	0
44	7	5	1	0	0
49	0	1	0	11	0
50	7	5	1	0	0
51	0	0	0	11	0
52	0	0	3	14	13
53	1	0	3	14	13
54	7	5	1	0	0
55	2	0	1	0	0
56	7	5	1	0	0
57	7	5	1	0	0
58	0	0	0	11	0
59	0	0	1	11	0
60	2	0	1	0	0
61	0	0	1	11	0
62	0	0	0	11	0

	ARITHMETICAL INSTRUCTIONS DEFINED													
MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	0	0	0	0	0	0	0	0	0	0	15	15
3	0	0	0	0	0	0	0	0	0	0	0	0	15	15
4	0	0	0	0	0	0	0	0	0	0	0	0	15	15
5	0	0	0	0	0	0	0	0	0	0	0	0	15	15
6	0	0	0	0	0	0	0	0	0	0	0	0	15	15
7	0	0	0	0	0	0	0	0	0	0	0	0	15	15
8	0	0	0	0	0	0	0	0	0	0	0	0	15	15
9	0	0	0	0	0	0	0	0	0	0	0	0	15	15
10	0	0	0	0	0	0	0	0	0	0	0	0	15	15
11	0	0	0	0	0	0	0	0	0	0	0	0	15	15
12	0	0	0	0	0	0	0	0	0	0	0	0	15	15
13	0	0	0	0	0	0	0	0	0	0	0	0	15	15
14	0	0	0	0	0	0	0	0	0	0	0	0	15	15
15	0	0	0	0	0	0	0	0	0	0	0	0	15	15
16	0	0	0	0	0	0	0	0	0	0	0	0	15	15
17	0	0	0	0	0	0	0	0	0	0	0	0	15	15
18	0	0	0	0	0	0	0	0	0	0	0	0	15	15
19	0	0	0	0	0	0	0	0	0	0	0	0	15	15
20	0	0	0	0	0	0	0	0	0	0	0	0	15	15
21	0	0	0	0	0	0	0	0	0	0	0	0	12	12
22	0	0	0	0	0	0	0	0	0	0	0	0	15	15
32	0	0	0	0	0	0	0	0	0	0	0	0	15	15
33	0	0	0	0	0	0	0	0	0	0	0	0	15	15
34	0	0	0	0	0	0	0	0	0	0	0	0	15	15
35	0	0	0	0	0	0	0	0	0	0	0	0	15	15
36	0	0	0	0	0	0	0	0	0	0	0	0	15	15
37	0	0	0	0	0	0	0	0	0	0	0	0	15	15
38	0	0	0	0	0	0	0	0	0	0	0	0	15	15
39	0	0	0	0	0	0	0	0	0	0	0	0	15	15
40	0	0	0	0	0	0	0	0	0	0	0	0	15	15
41	0	0	0	0	0	0	0	0	0	0	0	0	15	15
42	0	0	0	0	0	0	0	0	0	0	0	0	15	15
43	0	0	0	0	0	0	0	0	0	0	0	0	15	15
44	0	0	0	0	0	0	0	0	0	0	0	0	15	15
49	0	0	0	0	0	0	0	0	0	0	0	0	15	15
50	0	0	1	1	1	0	0	1	1	1	1	1	9	6
51	0	0	1	1	1	0	0	1	2	2	2	2	9	6
52	0	0	1	1	1	0	0	1	2	2	2	2	9	6
53	0	0	1	1	1	0	0	1	2	2	2	2	9	6
54	0	0	1	1	1	0	0	1	1	1	1	1	9	6
55	0	0	1	1	1	0	0	1	2	2	2	2	9	6
56	0	0	0	0	0	0	0	0	0	0	0	0	15	15
57	0	0	0	0	0	0	0	0	0	0	0	0	15	15
58	0	0	1	1	4	0	4	1	3	3	3	3	9	9
59	4	0	4	0	4	1	4	1	3	3	3	3	15	15
60	0	0	1	1	4	0	4	1	3	3	3	3	9	9
61	4	0	4	0	4	1	4	1	3	3	3	3	15	15
62	0	0	0	0	0	0	0	0	0	0	0	0	15	15

	ACCUMULATOR INSTRUCTIONS DEFINED						
MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	1	0	0	0	0	0	0
3	1	0	0	0	0	0	0
4	1	0	0	0	0	0	0
5	1	0	0	0	0	0	0
6	1	0	0	0	0	0	0
7	1	0	0	0	0	0	0
8	1	0	0	0	0	0	0
9	1	0	0	0	0	0	0
10	1	0	0	0	0	0	0
11	1	0	0	0	0	0	0
12	1	0	0	0	0	0	0
13	1	0	0	0	0	0	0
14	1	0	0	0	0	0	0
15	1	0	0	0	0	0	0
16	1	0	0	0	0	0	0
17	1	0	0	0	0	0	0
18	1	0	0	0	0	0	0
19	1	0	0	0	0	0	0
20	1	0	0	0	0	0	0
21	1	1	1	1	0	0	0
22	1	0	0	0	0	0	1
32	0	0	0	0	0	1	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0
49	1	0	0	1	0	0	0
50	1	0	0	0	0	0	0
51	1	1	1	1	0	0	0
52	1	1	1	0	0	0	0
53	1	1	1	0	0	0	0
54	1	0	0	0	0	0	0
55	1	1	1	0	1	0	0
56	1	0	0	0	0	0	0
57	1	0	0	1	0	0	0
58	1	1	1	1	0	0	0
59	1	1	1	0	0	0	0
60	1	0	1	0	1	0	0
61	1	1	1	0	0	0	0
62	1	0	0	0	0	0	0

	I/O INSTRUCTIONS DEFINED						
MEM-LOC.	SETF	CLEARF	SELECT	BUF.ADDR.	STROBE	I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT	CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	0
34	1	0	0	0	0	0
35	1	1	1	1	0	0
36	1	1	1	1	1	0
37	1	1	1	1	3	0
38	1	1	1	1	2	0
39	1	1	1	1	5	0
40	1	1	1	1	4	0
41	1	0	0	0	0	0
42	1	0	0	0	0	0
43	1	0	0	0	0	0
44	1	0	0	0	0	0
49	0	0	0	0	0	0
50	0	0	0	0	0	0
51	0	0	0	0	0	0
52	0	0	0	0	0	0
53	0	0	0	0	0	0
54	0	0	0	0	0	0
55	0	0	0	0	0	0
56	0	0	0	0	0	0
57	0	0	0	0	0	0
58	0	0	0	0	0	0
59	0	0	0	0	0	0
60	0	0	0	0	0	0
61	0	0	0	0	0	0
62	0	0	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE

FILE-NAME (NORD 10): GP8:DATA

PROGRAM DESCRIPTION:

CROSS CORRELATION

DATA CHANNEL 1

$$Re\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+(N+D-1)(r-1)} X_{i+S+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1)}\right)$$

DATA CHANNEL 2

$$Im\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+S+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1)}\right)$$

WHERE N=NO. OF SAMPLES IN RANGECELL

L=0,1,2,...,P P≤N-1

S=SAMPLE DIFFERENCE BETWEEN THE TWO SETS OF DATA

D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND≤0 FOR OVERLAPPING)

r=1,2,...,M RANGECELLS FOR TIME AVERAGE

MULTI PULSE

DATA CHANNEL 1 $Re\left\{K_{L,r}\right\} = X_{S+r-1} X_{S+L+r-1} + Y_{S+r-1} Y_{S+L+r-1}$

DATA CHANNEL 2 $Im\left\{K_{L,r}\right\} = X_{S+L+r-1} Y_{S+R-1} - X_{S+r-1} Y_{S+L+r-1}$

LET J_0=POSITION OF 1st PULSE

J_1=SAMPLE DIFFERENCE BETWEEN 1st AND 2nd PULSE

.

.

J_{N-1}=SAMPLE DISTANCE BETWEEN 1st AND Nth PULSE

START ADDRESS FOR PROGRAM:

PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE

FILE-NAME (NORD 10): GP8:DATA

PROGRAM DESCRIPTION:

POWER PROFILE

DATA CHANNEL 1 ZERO LAG ESTIMATION $K_r = \sum_{i=0}^{N-1} (X^2_{i+(N+D-1)(r-1)} + Y^2_{i+(N+D-1)(r-1)}$

DATA CHANNEL 2 MEAN VALUE ESTIMATION $M_r = \sum_{i=0}^{N-1} (X_{i+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)}$

WHERE N=NO. OF SAMPLES IN RANGECELL

D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND ≤0 FOR OVERLAPPING)

r=1,2,...,M RANGECELLS FOR TIME AVERAGE

SINGLE PULSE

DATA CHANNEL 1

$$Re\{K_{L,r}\} = \sum_{i=0}^{N-L-1} (X_{i+(N+D-1)(r-1)} X_{i+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

DATA CHANNEL 2

$$Im\{K_{L,r}\} = \sum_{i=0}^{N-L-1} (X_{i+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

WHERE N=NO. OF SAMPLES IN RANGECELL

L=0,1,2,...,P P≤N-1

D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND≤0 FOR OVERLAPPING)

r=1,2,...,M RANGECELLS FOR TIME AVERAGE

START ADDRESS FOR PROGRAM: 1

PROGRAM-MEMORY LOCATIONS USED: 1 - 26, 32 - 44, 49 - 62

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE
FILE-NAME (NORD 10): GP8:DATA
PROGRAM DESCRIPTION:

WHERE $S=J_0,J_1,J_2,\ldots,J_{N-2}$

$L=J_1-S,J_2-S,\ldots,J_{N-1}-S$ WITH THE RESTRICTION $L>0$

$r=1,2,\ldots,M$ RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

POWER PROFILE: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1

SINGLE PULSE: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
MINIMUM NO. OF LAGS IN RANGEDATA: 2

CROSS CORRELATION: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
MINIMUM NO. OF LAGS IN RANGEDATA: 2

MULTI PULSE: MINIMUM NO. OF ELEMENT PULSES IN PULSE GROUP: 2
MAXIMUM NO. OF ELEMENT PULSES IN PULSE GROUP: 4

NOTES

1. This program assumes that the start addresses of the buffer and result memories are zero.
2. The number of start computes counted is placed after the last data sample in the result memory. Therefore the real and imaginary parts of this location will contain the number of start computes counted as a negative number.
3. The location for the number of start computes counted must be included in the number of 64 BIT words for the DMA transfer, ie total number of samples computed+1 (for number of start computes counted).
4. The Status and Control words are transferred out before the data to the computer.

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE
FILE-NAME (NORD 10): GP8:DATA
PROGRAM DESCRIPTION:

NOTES (CONTINUED)

5. With the Cross Correlation program only half of the correlation function can be obtained.
6. With the Multi Pulse program the zero lag is not computed, therefore to calculate the number of lags computed use the formula: N(N-1)/2 where N is the number of element pulses in pulse group.
7. All X, Y samples must be placed contiguously in the buffer memory and all samples are written contiguously in the result memory.
8. In this scheme only one routine from the Power Profile, Single Pulse or Cross Correlation combination may be chosen as the first routine to be computed. The Multi Pulse routine is always computed second. The experiment must also be designed such that the data, noise and calibration samples from one of the "combination" routines be computed first and then the data, noise and calibration samples of the Multi Pulse routine second. Of course the data, noise and calibration samples of a particular routine may be computed in any order. The parameters for the first routine are indicated by PROG 1, likewise PROG 2, for the second routine in the PARAMETER field.

HOW TO GET THE ROUTINES

FOR PROG 1: POWER PROFILE: DEFINE APBRS(13)=0
SINGLE PULSE: DEFINE APBRS(11)=0
CROSS CORRELATION: DEFINE APBRS(13)≠0 AND APBRS(11)≠0

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE
FILE-NAME (NORD 10): GP8:DATA
PROGRAM DESCRIPTION:

EXECUTION TIMES FOR PROGRAMS

POWER PROFILE: $(19+2(R_1+R_2+R_3))x0.1666667$ usec N=1

$(19+(N+2)(R_1+R_2+R_3))x0.1666667$ usec $N \geqslant 2$

SINGLE PULSE AND CROSS CORRELATION:

$(13+(2N+(L(1-L)/2)+N(L-1)+1)(R_1+R_2+R_3))x0.1666667$ usec $N \geqslant 2$, $L \geqslant 2$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=NO. OF LAGS IN RANGECELL
R_1, R_2, R_3 =NO. OF RANGECELLS FOR DATA, NOISE AND CALIBRATION

MULTI PULSE: $(11+(N(N+1)/2+1)(R_1+R_2+R_3))x0.1666667$ usec $N \geqslant 2$

WHERE N=NO. OF PULSES IN PULSE GROUP
R_1, R_2, R_3 =NO. OF RANGECELLS FOR DATA, NOISE AND CALIBRATION

TOTAL TIME = TIME(PROG 1) + TIME(PROG 2) + 1.5000003 usec

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE
FILE-NAME (NORD 10): GP8:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF PROGRAM
DATAI REGISTER, APB	6	NO. OF 64 BIT WORDS FOR DMA TRANSFER
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 1
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 1st PROG 1
APB RS(13)	16,13	NO. OF LAGS-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 1
APB RS(12)	16,12	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS) PROG 1
APB RS(11)	16,11	START ADDRESS OF 2nd FIELD-START ADDRESS OF 1st FIELD PROG 1
APB RS(10)	16,10	SAMPLE INCREMENT PROG 1/RANGECELL INCREMENT PROG 2 (MUST=1)
APB RS(9)	16,9	TEMPORARY STORAGE
APB RS(8)	16,8	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 2nd PROG 1
APB RS(7)	16,7	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 3rd PROG 1
APB RS(6)	16,6	NO. OF PULSES-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 2
APB RS(5)	16,5	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 4th PROG 2
APB RS(4)	16,4	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 5th PROG 2
APB RS(3)	16,3	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 6th PROG 2
APB RS(2)	16,2	SAMPLE DISTANCE BETWEEN 3rd LAST AND 1st PULSE
APB RS(1)	16,1	SAMPLE DISTANCE BETWEEN 2nd LAST AND 1st PULSE

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE
FILE-NAME (NORD 10): GP8:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
APB RS(0)	16,0	SAMPLE INCREMENT BETWEEN LAST AND 1st PULSE
APM RS(15)	17,15	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED) PROG 1
APM RS(14)	17,14	INCREMENT (=1)
APM RS(13)	17,13	TEMPORARY STORAGE
APM RS(0)	17,0	INCREMENT FOR TRANSFER PROGRAM (=1)

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : (POWER PROFILE (VER.1) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	0	0	0	0	1	18
2	56	0	4	0	0	0	0	0	0	0
3	56	0	4	0	0	0	0	0	1	19
4	56	0	4	0	0	0	0	0	0	0
5	56	0	4	0	0	0	0	0	1	20
6	56	0	10	49	0	0	0	0	0	0
7	56	0	4	0	0	0	0	0	1	19
8	56	0	10	49	0	0	0	0	0	0
9	56	0	4	0	0	0	0	0	1	19
10	56	0	10	49	0	0	0	0	0	0
11	56	0	4	0	0	0	0	0	1	18
12	56	0	4	0	0	0	0	0	0	0
13	56	0	4	0	0	0	0	0	1	19
14	56	0	10	21	0	0	0	0	0	0
15	56	0	4	0	0	0	0	0	1	19
16	56	0	10	21	0	0	0	0	0	0
17	56	0	4	0	0	0	0	0	1	19
18	56	0	10	21	0	0	0	0	0	0
19	56	0	4	0	0	0	0	0	0	0
20	56	0	6	0	0	0	0	0	0	0
21	56	0	4	0	2	0	3	0	0	0
22	57	6	4	26	6	0	0	0	0	0
23	57	6	4	25	7	1	0	0	0	0
24	57	4	6	24	7	0	0	0	0	0
25	57	4	6	23	6	0	0	0	0	0
26	58	1	6	22	0	0	1	0	0	0
32	56	0	4	0	0	0	0	0	1	20
33	56	0	4	0	0	0	0	0	0	0
34	56	0	4	0	0	0	0	0	0	0
35	56	0	4	0	0	0	0	0	0	0
36	56	0	6	0	0	0	0	2	0	0
37	56	0	4	0	0	0	0	1	0	0
38	56	0	4	0	0	0	0	0	0	0
39	56	0	4	0	0	0	0	0	0	0
40	60	0	5	0	0	0	0	0	0	0
41	56	0	4	0	0	0	0	0	0	0
42	56	0	4	0	0	0	0	0	0	0
43	56	0	4	0	0	0	0	0	0	0
44	56	0	6	0	0	0	0	0	0	0
49	56	0	4	0	2	0	3	2	0	0
50	60	5	4	57	0	0	0	0	0	0
51	61	6	4	56	1	0	0	1	0	0
52	61	0	4	54	1	1	0	1	0	0
53	61	4	6	53	1	0	0	1	0	0
54	56	0	4	0	3	0	0	2	0	0
55	57	4	6	52	6	0	0	1	0	0
56	58	1	6	50	2	0	1	2	0	0
57	56	0	4	0	2	0	3	0	0	0
58	57	5	4	62	1	0	0	0	0	0
59	57	5	4	61	1	0	0	0	0	0
60	57	4	6	60	1	0	0	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	4	0	1	15	0	0
2	7	5	1	0	0	0
3	4	0	1	14	0	0
4	7	5	1	0	0	0
5	4	0	1	13	0	0
6	7	5	0	0	0	0
7	4	0	1	8	0	0
8	0	0	0	10	0	0
9	4	0	1	7	0	0
10	0	0	0	10	0	0
11	4	0	1	6	0	0
12	7	5	1	0	0	0
13	4	0	1	5	0	0
14	0	0	0	10	0	0
15	4	0	1	4	0	0
16	0	0	0	10	0	0
17	4	0	1	3	0	0
18	0	0	0	10	0	0
19	0	0	0	10	0	0
20	7	5	1	0	0	0
21	0	1	3	10	9	0
22	1	0	3	10	9	0
23	1	0	1	9	0	1
24	1	0	1	9	0	1
25	1	0	0	9	0	1
26	7	5	1	0	0	0
32	7	0	1	0	0	0
33	7	5	1	0	0	0
34	7	5	1	0	0	0
35	7	5	1	0	0	0
36	7	5	1	0	0	0
37	7	5	1	0	0	0
38	7	5	1	0	0	0
39	7	5	1	0	0	0
40	7	5	1	0	0	0
41	7	5	1	0	0	0
42	7	5	1	0	0	0
43	7	5	1	0	0	0
44	7	5	1	0	0	0
49	0	1	0	12	0	0
50	0	0	0	12	0	0
51	0	0	3	11	9	0
52	1	0	3	10	9	0
53	1	0	3	10	9	0
54	0	0	0	10	0	0
55	0	0	3	11	9	0
56	7	5	1	0	0	0
57	0	1	0	12	0	0
58	0	0	0	12	0	0
59	2	0	1	0	0	0
60	0	0	0	10	0	0
61	0	0	0	10	0	0
62	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	7	5	1	0	0
2	7	5	1	0	0
3	7	5	1	0	0
4	7	5	1	0	0
5	7	5	1	0	0
6	7	5	0	0	0
7	7	5	1	0	0
8	0	0	0	15	0
9	7	5	1	0	0
10	0	0	0	15	0
11	7	5	1	0	0
12	7	5	1	0	0
13	7	5	1	0	0
14	0	0	0	15	0
15	7	5	1	0	0
16	0	0	0	14	0
17	7	5	1	0	0
18	0	0	0	14	0
19	0	0	0	14	0
20	7	5	1	0	0
21	0	1	0	14	0
22	7	5	1	0	0
23	0	0	0	14	0
24	0	0	0	14	0
25	7	5	1	0	0
26	7	5	1	0	0
32	7	5	1	0	0
33	7	5	1	0	0
34	7	5	1	0	0
35	7	5	0	0	0
36	0	1	0	0	0
37	0	0	0	0	0
38	2	0	1	0	0
39	2	0	1	0	0
40	2	0	1	0	0
41	7	5	1	0	0
42	7	5	1	0	0
43	7	5	1	0	0
44	7	5	1	0	0
49	0	1	0	15	0
50	7	5	1	0	0
51	0	0	0	15	0
52	0	0	3	14	13
53	1	0	3	14	13
54	7	5	1	0	0
55	2	0	1	0	0
56	7	5	1	0	0
57	7	5	1	0	0
58	0	0	0	15	0
59	7	5	1	0	0
60	7	5	1	0	0
61	2	0	1	0	0
62	7	5	1	0	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	0	0	0	0	0	0	0	0	0	0	15	15
3	0	0	0	0	0	0	0	0	0	0	0	0	15	15
4	0	0	0	0	0	0	0	0	0	0	0	0	15	15
5	0	0	0	0	0	0	0	0	0	0	0	0	15	15
6	0	0	0	0	0	0	0	0	0	0	0	0	15	15
7	0	0	0	0	0	0	0	0	0	0	0	0	15	15
8	0	0	0	0	0	0	0	0	0	0	0	0	15	15
9	0	0	0	0	0	0	0	0	0	0	0	0	15	15
10	0	0	0	0	0	0	0	0	0	0	0	0	15	15
11	0	0	0	0	0	0	0	0	0	0	0	0	15	15
12	0	0	0	0	0	0	0	0	0	0	0	0	15	15
13	0	0	0	0	0	0	0	0	0	0	0	0	15	15
14	0	0	0	0	0	0	0	0	0	0	0	0	15	15
15	0	0	0	0	0	0	0	0	0	0	0	0	15	15
16	0	0	0	0	0	0	0	0	0	0	0	0	15	15
17	0	0	0	0	0	0	0	0	0	0	0	0	15	15
18	0	0	0	0	0	0	0	0	0	0	0	0	15	15
19	0	0	0	0	0	0	0	0	0	0	0	0	12	12
20	0	0	0	0	0	0	0	0	0	0	0	0	15	15
21	0	0	0	0	0	0	0	0	0	0	0	0	15	15
22	0	0	1	1	1	0	0	1	3	3	3	3	9	6
23	0	0	1	1	1	0	0	1	2	2	2	2	9	6
24	0	0	1	1	1	0	0	1	2	2	2	2	9	6
25	0	0	1	1	1	0	0	1	3	3	3	3	9	6
26	0	0	0	0	0	0	0	0	0	0	0	0	15	15
32	0	0	0	0	0	0	0	0	0	0	0	0	15	15
33	0	0	0	0	0	0	0	0	0	0	0	0	15	15
34	0	0	0	0	0	0	0	0	0	0	0	0	15	15
35	0	0	0	0	0	0	0	0	0	0	0	0	15	15
36	0	0	0	0	0	0	0	0	0	0	0	0	15	15
37	0	0	0	0	0	0	0	0	0	0	0	0	15	15
38	0	0	0	0	0	0	0	0	0	0	0	0	15	15
39	0	0	0	0	0	0	0	0	0	0	0	0	15	15
40	0	0	0	0	0	0	0	0	0	0	0	0	15	15
41	0	0	0	0	0	0	0	0	0	0	0	0	15	15
42	0	0	0	0	0	0	0	0	0	0	0	0	15	15
43	0	0	0	0	0	0	0	0	0	0	0	0	15	15
44	0	0	0	0	0	0	0	0	0	0	0	0	15	15
49	0	0	0	0	0	0	0	0	0	0	0	0	15	15
50	0	0	1	1	1	0	0	1	1	1	1	1	9	6
51	0	0	1	1	1	0	0	1	2	2	2	2	9	6
52	0	0	1	1	1	0	0	1	2	2	2	2	9	6
53	0	0	1	1	1	0	0	1	2	2	2	2	9	6
54	0	0	1	1	1	0	0	1	1	1	1	1	9	6
55	0	0	1	1	1	0	0	1	2	2	2	2	9	6
56	0	0	0	0	0	0	0	0	0	0	0	0	15	15
57	0	0	0	0	0	0	0	0	0	0	0	0	15	15
58	0	0	1	1	4	0	4	1	3	3	3	3	9	9
59	0	0	0	0	0	0	0	0	3	3	3	3	6	6
60	0	0	1	1	4	0	4	1	3	3	3	3	9	9
61	0	0	1	1	4	0	4	1	3	3	3	3	9	9
62	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	1	0	0	0	0	0	0
3	1	0	0	0	0	0	0
4	1	0	0	0	0	0	0
5	1	0	0	0	0	0	0
6	1	0	0	0	0	0	0
7	1	0	0	0	0	0	0
8	1	0	0	0	0	0	0
9	1	0	0	0	0	0	0
10	1	0	0	0	0	0	0
11	1	0	0	0	0	0	0
12	1	0	0	0	0	0	0
13	1	0	0	0	0	0	0
14	1	0	0	0	0	0	0
15	1	0	0	0	0	0	0
16	1	0	0	0	0	0	0
17	1	0	0	0	0	0	0
18	1	0	0	0	0	0	0
19	1	1	1	1	0	0	0
20	1	0	0	0	0	0	1
21	1	0	0	1	0	0	0
22	1	0	0	0	0	0	0
23	1	1	1	0	0	0	0
24	1	1	1	0	0	0	0
25	1	0	0	0	0	0	0
26	1	0	0	0	0	0	0
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	1	0
49	1	0	0	1	0	0	0
50	1	0	0	0	0	0	0
51	1	1	1	1	0	0	0
52	1	1	1	0	0	0	0
53	1	1	1	0	0	0	0
54	1	0	0	0	0	0	0
55	1	1	1	0	1	0	0
56	1	0	0	0	0	0	0
57	1	0	0	1	0	0	0
58	1	1	1	0	0	0	0
59	1	0	0	0	0	0	0
60	1	0	0	0	0	0	0
61	1	1	0	0	0	0	0
62	1	0	0	0	0	0	0

	I/O INSTRUCTIONS DEFINED					
MEM-LOC.	SETF	CLEARF	SELECT BUF.ADDR.	STROBE I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0
25	0	0	0	0	0	0
26	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	0
34	0	0	0	0	0	0
35	0	0	0	0	0	0
36	0	0	0	0	0	0
37	0	0	0	0	0	0
38	0	0	0	0	0	0
39	0	0	0	0	0	0
40	0	0	0	0	0	0
41	0	0	0	0	0	0
42	0	0	0	0	0	0
43	0	0	0	0	0	0
44	0	0	0	0	0	0
49	0	0	0	0	0	0
50	0	0	0	0	0	0
51	0	0	0	0	0	0
52	0	0	0	0	0	0
53	0	0	0	0	0	0
54	0	0	0	0	0	0
55	0	0	0	0	0	0
56	0	0	0	0	0	0
57	0	0	0	0	0	0
58	0	0	0	0	0	0
59	0	0	0	0	0	0
60	0	0	0	0	0	0
61	0	0	0	0	0	0
62	0	0	0	0	0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT	CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0
25	0	0	0	0	0	0
26	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	0
34	1	0	0	0	0	0
35	1	1	1	0	0	0
36	1	1	1	1	0	0
37	1	1	1	3	0	0
38	1	1	1	2	0	0
39	1	1	1	5	0	0
40	1	1	1	4	0	0
41	1	0	0	0	0	0
42	1	0	0	0	0	0
43	1	0	0	0	0	0
44	1	0	0	0	0	0
49	0	0	0	0	0	0
50	0	0	0	0	0	0
51	0	0	0	0	0	0
52	0	0	0	0	0	0
53	0	0	0	0	0	0
54	0	0	0	0	0	0
55	0	0	0	0	0	0
56	0	0	0	0	0	0
57	0	0	0	0	0	0
58	0	0	0	0	0	0
59	0	0	0	0	0	0
60	0	0	0	0	0	0
61	0	0	0	0	0	0
62	0	0	0	0	0	0

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE

FILE-NAME (NORD 10): GP9:DATA

PROGRAM DESCRIPTION:

POWER PROFILE

DATA CHANNEL 1 ZERO LAG ESTIMATION $K_r = \sum_{i=0}^{N-1} (X^2_{i+(N+D-1)(r-1)} + Y^2_{i+(N+D-1)(r-1)})$

DATA CHANNEL 2 MEAN VALUE ESTIMATION $M_r = \sum_{i=0}^{N-1} (X_{i+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)})$

DATA CHANNEL 1 MEAN VALUE X ESTIMATION $M_{X,r} = \sum_{i=0}^{N-1} X_{i+(N+D-1)(r-1)}$

DATA CHANNEL 2 MEAN VALUE Y ESTIMATION $M_{Y,r} = \sum_{i=0}^{N-1} Y_{i+(N+D-1)(r-1)}$

WHERE N=NO. OF SAMPLES IN RANGECELL

D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND $\leq$0 FOR OVERLAPPING)

r=1,2,...,M RANGECELLS FOR TIME AVERAGE

SINGLE PULSE

DATA CHANNEL 1

$$\mathrm{Re}\{K_{L,r}\} = \sum_{i=0}^{N-L-1} (X_{i+(N+D-1)(r-1)} X_{i+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

DATA CHANNEL 2

$$\mathrm{Im}\{K_{L,r}\} = \sum_{i=0}^{N-L-1} (X_{i+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+L+(N+D-1)(r-1)})$$

WHERE N=NO. OF SAMPLES IN RANGECELL

L=0,1,2,...,P P$\leq$N-1

D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND$\leq$0 FOR OVERLAPPING)

r=1,2,...,M RANGECELLS FOR TIME AVERAGE

START ADDRESS FOR PROGRAM: 1

PROGRAM-MEMORY LOCATIONS USED: 1 - 26, 32 - 44, 49 - 62

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE

FILE-NAME (NORD 10): GP9:DATA

PROGRAM DESCRIPTION:

CROSS CORRELATION

DATA CHANNEL 1

$$\mathrm{Re}\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+(N+D-1)(r-1)} X_{i+S+L+(N+D-1)(r-1)} + Y_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1)}\right)$$

DATA CHANNEL 2

$$\mathrm{Im}\left\{K_{L,r}\right\} = \sum_{i=0}^{N-L-1} \left(X_{i+S+L+(N+D-1)(r-1)} Y_{i+(N+D-1)(r-1)} - X_{i+(N+D-1)(r-1)} Y_{i+S+L+(N+D-1)(r-1)}\right)$$

WHERE N=NO. OF SAMPLES IN RANGECELL

L=0,1,2,...,P $P \leqslant N-1$

S=SAMPLE DIFFERENCE BETWEEN THE TWO SETS OF DATA

D=OVERLAP FACTOR (=1 FOR NO OVERLAPPING AND $\leqslant$0 FOR OVERLAPPING)

r=1,2,...,M RANGECELLS FOR TIME AVERAGE

MULTI PULSE

DATA CHANNEL 1 $\mathrm{Re}\left\{K_{L,r}\right\} = X_{S+r-1} X_{S+L+r-1} + Y_{S+r-1} Y_{S+L+r-1}$

DATA CHANNEL 2 $\mathrm{Im}\left\{K_{L,r}\right\} = X_{S+L+r-1} Y_{S+R-1} - X_{S+r-1} Y_{S+L+r-1}$

LET J_0=POSITION OF 1st PULSE

J_1=SAMPLE DIFFERENCE BETWEEN 1st AND 2nd PULSE

.

.

J_{N-1}=SAMPLE DIFFERENCE BETWEEN 1st AND Nth PULSE

START ADDRESS FOR PROGRAM:

PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE
FILE-NAME (NORD 10): GP9:DATA
PROGRAM DESCRIPTION:

WHERE $S=J_0,J_1,J_2,\ldots,J_{N-2}$

$L=J_1-S,J_2-S,\ldots,J_{N-1}-S$ WITH THE RESTRICTION $L>0$

$r=1,2,\ldots,M$ RANGECELLS FOR TIME AVERAGE

RESTRICTIONS

POWER PROFILE: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1

SINGLE PULSE: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
MINIMUM NO. OF LAGS IN RANGEDATA: 2

CROSS CORRELATION: MINIMUM NO. OF SAMPLES IN RANGEDATA: 1
MINIMUM NO. OF LAGS IN RANGEDATA: 2

MULTI PULSE: MINIMUM NO. OF ELEMENT PULSES IN PULSE GROUP: 2
MAXIMUM NO. OF ELEMENT PULSES IN PULSE GROUP: 4

NOTES

1. This program assumes that the start addresses of the buffer and result memories are zero.
2. The number of start computes counted is placed after the last data sample in the result memory. Therefore the real and imaginary parts of this location will contain the number of start computes counted as a negative number.
3. The location for the number of start computes counted must be included in the number of 64 BIT words for the DMA transfer, ie total number of samples computed+1 (for number of start computes counted).
4. The Status and Control words are transferred out before the data to the computer.

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE
FILE-NAME (NORD 10): GP9:DATA
PROGRAM DESCRIPTION:

NOTES CONTINUED

5. For the Power Profile program in a particular rangecell the zero lag estimation K_r and M_r are computed first and the mean value estimation $M_{X,r}$ and $M_{Y,r}$ second.
6. With the Cross Correlation program only half of the correlation function can be obtained.
7. With the Multi Pulse program the zero lag is not computed, therefore to calculate the number of lags computed use the formula: N(N-1)/2 where N is the number of element pulses in pulse group.
8. All X, Y samples must be placed contiguously in the buffer memory and all samples are written contiguously in the result memory.
9. In this scheme only one routine from the Power Profile, Single Pulse or Cross Correlation combination may be chosen as the first routine to be computed. The Multi Pulse routine is always computed second. The experiment must also be designed such that the data, noise and calibration samples from one of the "combination" routines be computed first and then the data, noise and calibration samples of the Multi Pulse routine second. Of course the data, noise and calibration samples of a particular routine may be computed in any order. The parameters for the first routine are indicated by PROG 1, likewise PROG 2, for the second routine in the PARAMETER field.

HOW TO GET THE ROUTINES

FOR PROG 1: POWER PROFILE: DEFINE APBRS(13)=0
SINGLE PULSE: DEFINE APBRS(11)=0
CROSS CORRELATION: DEFINE APBRS(13)≠0 AND APBRS(11)≠0

START ADDRESS FOR PROGRAM:
PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE

FILE-NAME (NORD 10): GP9:DATA

PROGRAM DESCRIPTION:

EXECUTION TIMES FOR PROGRAMS

POWER PROFILE: $(19+(2N+1)(R_1+R_2+R_3))x0.1666667$ usec $N \geq 1$

SINGLE PULSE AND CROSS CORRELATION:

$(13+(2N+(L(1-L)/2)+N(L-1)+1)(R_1+R_2+R_3))x0.1666667$ usec $N \geq 2$, $L \geq 2$

WHERE N=NO. OF SAMPLES IN RANGECELL
L=NO. OF LAGS IN RANGECELL
R_1, R_2, R_3 =NO. OF RANGECELLS FOR DATA, NOISE AND CALIBRATION

MULTI PULSE: $(11+(N(N+1)/2+1)(R_1+R_2+R_3))x0.1666667$ usec $N \geq 2$

WHERE N=NO. OF PULSES IN PULSE GROUP
R_1, R_2, R_3 =NO. OF RANGECELLS FOR DATA, NOISE AND CALIBRATION

TOTAL TIME = TIME(PROG 1) + TIME(PROG 2) + 1.5000003 usec

START ADDRESS FOR PROGRAM:

PROGRAM-MEMORY LOCATIONS USED:

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE
FILE-NAME (NORD 10): GP9:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
SAR	4	START ADDRESS OF PROGRAM
DATAI REGISTER, APB	6	NO. OF 64 BIT WORDS FOR DMA TRANSFER
APB RS(15)	16,15	NO. OF SAMPLES-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 1
APB RS(14)	16,14	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 1st PROG 1
APB RS(13)	16,13	NO. OF LAGS-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 1
APB RS(12)	16,12	RANGECELL INCREMENT (=1 FOR NO OVER-LAPPING OF RANGECELLS) PROG 1
APB RS(11)	16,11	START ADDRESS OF 2nd FIELD-START ADDRESS OF 1st FIELD PROG 1
APB RS(10)	16,10	SAMPLE INCREMENT PROG 1/RANGECELL INCREMENT PROG 2 (MUST=1)
APB RS(9)	16,9	TEMPORARY STORAGE
APB RS(8)	16,8	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 2nd PROG 1
APB RS(7)	16,7	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 3rd PROG 1
APB RS(6)	16,6	NO. OF PULSES-1 IN RANGECELL (DATA AND NOISE AND CALIBRATION) PROG 2
APB RS(5)	16,5	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 4th PROG 2
APB RS(4)	16,4	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 5th PROG 2
APB RS(3)	16,3	NO. OF RANGECELLS-1 FOR TIME AVERAGE (DATA OR NOISE OR CALIBRATION) COMPUTED 6th PROG 2
APB RS(2)	16,2	SAMPLE DISTANCE BETWEEN 3rd LAST AND 1st PULSE
APB RS(1)	16,1	SAMPLE DISTANCE BETWEEN 2nd LAST AND 1st PULSE

MICRO-PROGRAM FOR DIGITAL CORRELATOR

AUTOR: TERRANCE HO DATE: 6/8/80

PROGRAM NAME: (POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE
FILE-NAME (NORD 10): GP9:DATA

REGISTER NAME	REGISTER ADDRESS	PARAMETER
APB RS(0)	16,0	SAMPLE INCREMENT BETWEEN LAST AND 1st PULSE
APM RS(15)	17,15	RANGECELL INCREMENT (=NO. OF LAGS COMPUTED) PROG 1
APM RS(14)	17,14	INCREMENT (=1)
APM RS(13)	17,13	TEMPORARY STORAGE
APM RS(0)	17,0	INCREMENT FOR TRANSFER PROGRAM (=1)

*** CORRELATOR SIMULATOR ***

PROGRAM NAME : (POWER PROFILE (VER.2) OR SINGLE PULSE OR CROSS CORRELATION) AND MULTI PULSE

CODING (INTEGER) OF SEPARATE CORRELATOR FUNCTIONS

PROGRAM-INSTRUCTIONS DEFINED

MEM-LOC.	COND.CODE	CODE-B	CODE-A	ADDR.	LC1	LCR1A	LC2	LC3	RELOAD	R-ADDR.
0	56	0	4	0	0	0	0	0	0	0
1	56	0	4	0	0	0	0	0	1	18
2	56	0	4	0	0	0	0	0	0	0
3	56	0	4	0	0	0	0	0	1	19
4	56	0	4	0	0	0	0	0	0	0
5	56	0	4	0	0	0	0	0	1	20
6	56	0	10	49	0	0	0	0	0	0
7	56	0	4	0	0	0	0	0	1	19
8	56	0	10	49	0	0	0	0	0	0
9	56	0	4	0	0	0	0	0	1	19
10	56	0	10	49	0	0	0	0	0	0
11	56	0	4	0	0	0	0	0	1	18
12	56	0	4	0	0	0	0	0	0	0
13	56	0	4	0	0	0	0	0	1	19
14	56	0	10	21	0	0	0	0	0	0
15	56	0	4	0	0	0	0	0	1	19
16	56	0	10	21	0	0	0	0	0	0
17	56	0	4	0	0	0	0	0	1	19
18	56	0	10	21	0	0	0	0	0	0
19	56	0	4	0	0	0	0	0	0	0
20	56	0	6	0	0	0	0	0	0	0
21	56	0	4	0	2	0	3	0	0	0
22	57	6	4	26	6	0	0	0	0	0
23	57	6	4	25	7	1	0	0	0	0
24	57	4	6	24	7	0	0	0	0	0
25	57	4	6	23	6	0	0	0	0	0
26	53	1	6	22	0	0	1	0	0	0
32	56	0	4	0	0	0	0	0	1	20
33	56	0	4	0	0	0	0	0	0	0
34	56	0	4	0	0	0	0	0	0	0
35	56	0	4	0	0	0	0	0	0	0
36	56	0	0	0	0	0	0	2	0	0
37	56	0	4	0	0	0	0	1	0	0
38	56	0	4	0	0	0	0	0	0	0
39	56	0	4	0	0	0	0	0	0	0
40	60	0	5	0	0	0	0	0	0	0
41	56	0	4	0	0	0	0	0	0	0
42	56	0	4	0	0	0	0	0	0	0
43	56	0	4	0	0	0	0	0	0	0
44	56	0	0	0	0	0	0	0	0	0
49	56	0	4	0	2	0	3	0	0	0
50	60	6	4	57	0	0	0	0	0	0
51	61	6	4	56	1	0	0	1	0	0
52	61	6	4	54	1	1	0	1	0	0
53	61	4	6	53	1	0	0	1	0	0
54	56	0	6	0	3	0	0	2	0	0
55	57	4	6	52	6	0	0	1	0	0
56	56	1	6	50	2	0	1	2	0	0
57	56	0	4	0	2	0	3	0	0	0
58	56	0	4	0	0	0	0	0	0	0
59	57	6	4	62	1	0	0	0	0	0
60	56	0	4	0	0	0	0	0	0	0
61	57	4	6	60	1	0	0	0	0	0
62	56	1	6	58	2	0	1	0	0	0

APB-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.	SELECT
0	7	5	1	0	0	0
1	4	0	1	15	0	0
2	7	5	1	0	0	0
3	4	0	1	14	0	0
4	7	5	1	0	0	0
5	4	0	1	13	0	0
6	7	5	0	0	0	0
7	4	0	1	8	0	0
8	0	0	0	10	0	0
9	4	0	1	7	0	0
10	0	0	0	10	0	0
11	4	0	1	6	0	0
12	7	5	1	0	0	0
13	4	0	1	5	0	0
14	0	0	0	10	0	0
15	4	0	1	4	0	0
16	0	0	0	10	0	0
17	4	0	1	3	0	0
18	0	0	0	10	0	0
19	0	0	0	10	0	0
20	7	5	1	0	0	0
21	0	1	3	10	9	0
22	1	0	3	10	9	0
23	1	0	1	9	0	1
24	1	0	1	9	0	1
25	1	0	0	9	0	1
26	7	5	1	0	0	0
32	7	0	1	0	0	0
33	7	5	1	0	0	0
34	7	5	1	0	0	0
35	7	5	1	0	0	0
36	7	5	1	0	0	0
37	7	5	1	0	0	0
38	7	5	1	0	0	0
39	7	5	1	0	0	0
40	7	5	1	0	0	0
41	7	5	1	0	0	0
42	7	5	1	0	0	0
43	7	5	1	0	0	0
44	7	5	1	0	0	0
49	0	1	0	12	0	0
50	0	0	0	12	0	0
51	0	0	3	11	9	0
52	1	0	3	10	9	0
53	1	0	3	10	9	0
54	0	0	0	10	0	0
55	0	0	3	11	9	0
56	7	5	1	0	0	0
57	0	1	0	12	0	0
58	0	0	0	12	0	0
59	2	0	1	0	0	0
60	0	0	0	10	0	0
61	2	0	1	0	0	0
62	7	5	1	0	0	0

APM-INSTRUCTIONS DEFINED

MEM-LOC.	ALU-SOURCE	ALU-FUNCTION	ALU-DESTIN.	A-ADDR.	B-ADDR.
0	7	5	1	0	0
1	7	5	1	0	0
2	7	5	1	0	0
3	7	5	1	0	0
4	7	5	1	0	0
5	7	5	1	0	0
6	7	5	0	0	0
7	7	5	1	0	0
8	0	0	0	15	0
9	7	5	1	0	0
10	0	0	0	15	0
11	7	5	1	0	0
12	7	5	1	0	0
13	7	5	1	0	0
14	0	0	0	15	0
15	7	5	1	0	0
16	0	0	0	14	0
17	7	5	1	0	0
18	0	0	0	14	0
19	0	0	0	14	0
20	7	5	1	0	0
21	0	1	0	14	0
22	7	5	1	0	0
23	0	0	0	14	0
24	0	0	0	14	0
25	7	5	1	0	0
26	7	5	1	0	0
32	7	5	1	0	0
33	7	5	1	0	0
34	7	5	1	0	0
35	7	5	0	0	0
36	0	1	0	0	0
37	0	0	0	0	0
38	2	0	1	0	0
39	2	0	1	0	0
40	2	0	1	0	0
41	7	5	1	0	0
42	7	5	1	0	0
43	7	5	1	0	0
44	7	5	1	0	0
49	0	1	0	15	0
50	7	5	1	0	0
51	0	0	0	15	0
52	0	0	3	14	13
53	1	0	3	14	13
54	7	5	1	0	0
55	2	0	1	0	0
56	7	5	1	0	0
57	7	5	1	0	0
58	0	0	0	15	0
59	0	0	1	15	0
60	2	0	1	0	0
61	0	0	1	15	0
62	0	0	0	15	0

ARITHMETICAL INSTRUCTIONS DEFINED

MEM-LOC.	M1A	M1B	M2A	M2B	M3A	M3B	M4A	M4B	SM1	SM2	SM3	SM4	M12	M34
0	0	0	0	0	0	0	0	0	0	0	0	0	15	15
1	0	0	0	0	0	0	0	0	0	0	0	0	15	15
2	0	0	0	0	0	0	0	0	0	0	0	0	15	15
3	0	0	0	0	0	0	0	0	0	0	0	0	15	15
4	0	0	0	0	0	0	0	0	0	0	0	0	15	15
5	0	0	0	0	0	0	0	0	0	0	0	0	15	15
6	0	0	0	0	0	0	0	0	0	0	0	0	15	15
7	0	0	0	0	0	0	0	0	0	0	0	0	15	15
8	0	0	0	0	0	0	0	0	0	0	0	0	15	15
9	0	0	0	0	0	0	0	0	0	0	0	0	15	15
10	0	0	0	0	0	0	0	0	0	0	0	0	15	15
11	0	0	0	0	0	0	0	0	0	0	0	0	15	15
12	0	0	0	0	0	0	0	0	0	0	0	0	15	15
13	0	0	0	0	0	0	0	0	0	0	0	0	15	15
14	0	0	0	0	0	0	0	0	0	0	0	0	15	15
15	0	0	0	0	0	0	0	0	0	0	0	0	15	15
16	0	0	0	0	0	0	0	0	0	0	0	0	15	15
17	0	0	0	0	0	0	0	0	0	0	0	0	15	15
18	0	0	0	0	0	0	0	0	0	0	0	0	15	15
19	0	0	0	0	0	0	0	0	0	0	0	0	12	12
20	0	0	0	0	0	0	0	0	0	0	0	0	15	15
21	0	0	0	0	0	0	0	0	0	0	0	0	15	15
22	0	0	1	1	1	0	0	1	3	3	3	3	9	6
23	0	0	1	1	1	0	0	1	2	2	2	2	9	6
24	0	0	1	1	1	0	0	1	2	2	2	2	9	6
25	0	0	1	1	1	0	0	1	3	3	3	3	9	6
26	0	0	0	0	0	0	0	0	0	0	0	0	15	15
32	0	0	0	0	0	0	0	0	0	0	0	0	15	15
33	0	0	0	0	0	0	0	0	0	0	0	0	15	15
34	0	0	0	0	0	0	0	0	0	0	0	0	15	15
35	0	0	0	0	0	0	0	0	0	0	0	0	15	15
36	0	0	0	0	0	0	0	0	0	0	0	0	15	15
37	0	0	0	0	0	0	0	0	0	0	0	0	15	15
38	0	0	0	0	0	0	0	0	0	0	0	0	15	15
39	0	0	0	0	0	0	0	0	0	0	0	0	15	15
40	0	0	0	0	0	0	0	0	0	0	0	0	15	15
41	0	0	0	0	0	0	0	0	0	0	0	0	15	15
42	0	0	0	0	0	0	0	0	0	0	0	0	15	15
43	0	0	0	0	0	0	0	0	0	0	0	0	15	15
44	0	0	0	0	0	0	0	0	0	0	0	0	15	15
49	0	0	0	0	0	0	0	0	0	0	0	0	15	15
50	0	0	1	1	1	0	0	1	1	1	1	1	9	6
51	0	0	1	1	1	0	0	1	2	2	2	2	9	6
52	0	0	1	1	1	0	0	1	2	2	2	2	9	6
53	0	0	1	1	1	0	0	1	2	2	2	2	9	6
54	0	0	1	1	1	0	0	1	1	1	1	1	9	6
55	0	0	1	1	1	0	0	1	2	2	2	2	9	6
56	0	0	0	0	0	0	0	0	0	0	0	0	15	15
57	0	0	0	0	0	0	0	0	0	0	0	0	15	15
58	0	0	1	1	4	0	4	1	3	3	3	3	9	9
59	4	0	4	0	4	1	4	1	3	3	3	3	15	15
60	0	0	1	1	4	0	4	1	3	3	3	3	9	9
61	4	0	4	0	4	1	4	1	3	3	3	3	15	15
62	0	0	0	0	0	0	0	0	0	0	0	0	15	15

ACCUMULATOR INSTRUCTIONS DEFINED

MEM-LOC.	STROBE I/O	WRITE	READ	CLEAR1	SET1	CLEAR2	SET2
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	1	0	0	0	0	0	0
3	1	0	0	0	0	0	0
4	1	0	0	0	0	0	0
5	1	0	0	0	0	0	0
6	1	0	0	0	0	0	0
7	1	0	0	0	0	0	0
8	1	0	0	0	0	0	0
9	1	0	0	0	0	0	0
10	1	0	0	0	0	0	0
11	1	0	0	0	0	0	0
12	1	0	0	0	0	0	0
13	1	0	0	0	0	0	0
14	1	0	0	0	0	0	0
15	1	0	0	0	0	0	0
16	1	0	0	0	0	0	0
17	1	0	0	0	0	0	0
18	1	0	0	0	0	0	0
19	1	1	1	1	0	0	0
20	1	0	0	0	0	0	1
21	1	0	0	1	0	0	0
22	1	0	0	0	0	0	0
23	1	1	1	0	0	0	0
24	1	1	1	0	0	0	0
25	1	0	0	0	0	0	0
26	1	0	0	0	0	0	0
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	1	0
49	1	0	0	1	0	0	0
50	1	0	0	0	0	0	0
51	1	1	1	1	0	0	0
52	1	1	1	0	0	0	0
53	1	1	1	0	0	0	0
54	1	0	0	0	0	0	0
55	1	1	1	0	1	0	0
56	1	0	0	0	0	0	0
57	1	0	0	1	0	0	0
58	1	1	1	1	0	0	0
59	1	1	1	0	0	0	0
60	1	1	1	0	1	0	0
61	1	1	1	0	0	0	0
62	1	0	0	0	0	0	0

I/O INSTRUCTIONS DEFINED

MEM-LOC.	SETF	CLEARF	SELECT BUF.ADDR.	STROBE I-REG.	ENABLE EDB	ENABLE EAB
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0
25	0	0	0	0	0	0
26	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	0
34	0	0	0	0	0	0
35	0	0	0	0	0	0
36	0	0	0	0	0	0
37	0	0	0	0	0	0
38	0	0	0	0	0	0
39	0	0	0	0	0	0
40	0	0	0	0	0	0
41	0	0	0	0	0	0
42	0	0	0	0	0	0
43	0	0	0	0	0	0
44	0	0	0	0	0	0
49	0	0	0	0	0	0
50	0	0	0	0	0	0
51	0	0	0	0	0	0
52	0	0	0	0	0	0
53	0	0	0	0	0	0
54	0	0	0	0	0	0
55	0	0	0	0	0	0
56	0	0	0	0	0	0
57	0	0	0	0	0	0
58	0	0	0	0	0	0
59	0	0	0	0	0	0
60	0	0	0	0	0	0
61	0	0	0	0	0	0
62	0	0	0	0	0	0

OUTPUT-TRANSFER INSTRUCTIONS DEFINED

MEM-LOC.	TRANSFER	INHIBIT	CLOCK	DATA-READY	TRANSFER-CODE	SOURCE
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0
25	0	0	0	0	0	0
26	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	0
34	1	0	0	0	0	0
35	1	1	1	0	0	0
36	1	1	1	1	0	0
37	1	1	1	3	0	0
38	1	1	1	2	0	0
39	1	1	1	5	0	0
40	1	1	1	4	0	0
41	1	0	0	0	0	0
42	1	0	0	0	0	0
43	1	0	0	0	0	0
44	1	0	0	0	0	0
49	0	0	0	0	0	0
50	0	0	0	0	0	0
51	0	0	0	0	0	0
52	0	0	0	0	0	0
53	0	0	0	0	0	0
54	0	0	0	0	0	0
55	0	0	0	0	0	0
56	0	0	0	0	0	0
57	0	0	0	0	0	0
58	0	0	0	0	0	0
59	0	0	0	0	0	0
60	0	0	0	0	0	0
61	0	0	0	0	0	0
62	0	0	0	0	0	0

Further Literature:

HANS-JØRGEN ALKER: "A PROGRAMMABLE CORRELATOR MODULE FOR THE EISCAT RADAR SYSTEM".
EISCAT Technical Notes No. 79/11, 1979

TERRANCE HO
HANS-JØRGEN ALKER: "SCIENTIFIC PROGRAMMING OF THE EISCAT DIGITAL CORRELATOR. (REVISED)"
EISCAT Technical Notes No. 81/24, 1981

TERRANCE HO: "PROGRAMS CORRSIM, CORRTEST: SYSTEM FOR PROGRAM DEVELOPMENT AND SOFTWARE SIMULATION OF EISCAT DIGITAL CORRELATOR. USER'S MANUAL."
EISCAT Technical Notes No. 81/25, 1981

TERRANCE HO: "INSTRUCTION MANUAL FOR EISCAT DIGITAL CORRELATOR (REVISED)"
EISCAT Technical Notes No. 81/26, 1981

TERRANCE HO: "POCKET MANUAL FOR PROGRAMMING THE EISCAT DIGITAL CORRELATOR."
EISCAT Technical Notes No. 81/28, 1981

EISCAT publications

F. du Castel, O. Holt, B. Hultqvist, H. Kohl and M. Tiuri:
A European Incoherent Scatter Facility in the Auroral Zone (EISCAT).
A Feasibility Study ("The Green Report") June 1971. (Out of print).

O. Bratteng and A. Haug:
Model Ionosphere at High Latitude, EISCAT Feasibility Study, Report No. 9.
The Auroral Observatory, Tromsö July 1971. (Out of print).

A European Incoherent Scatter Facility in the Auroral Zone, UHF System and Organization ("The Yellow Report"), June 1974.

EISCAT Annual Report 1976.(Out of print).

P.S. Kildal and T. Hagfors:
Balance between investment in reflector and feed in the VHF cylindrical antenna.
EISCAT Technical Notes No. 77/1, 1977.

T. Hagfors:
Least mean square fitting of data to physical models.
EISCAT Technical Notes No. 78/2, 1978.

T. Hagfors:
The effect of ice on an antenna reflector.
EISCAT Technical Notes No. 78/3, 1978.

T. Hagfors:
The bandwidth of a linear phased array with stepped delay corrections.
EISCAT Technical Notes No. 78/4, 1978.

Data Group meeting in Kiruna, Sweden, 18-20 Jan. 1978
EISCAT Meetings No. 78/1, 1978

H-J. Alker:
Measurement principles in the EISCAT system
EISCAT Technical Notes No. 78/5, 1978

EISCAT Data Group meeting in Tromsö, Norway 30-31 May, 1978
EISCAT Meetings No. 78/2, 1978.

P-S. Kildal:
Discrete phase steering by permuting precut phase cables.
EISCAT Technical Notes No. 78/6, 1978

EISCAT UHF antenna acceptance test.
EISCAT Technical Notes No. 78/7, 1978.

P-S. Kildal:
Feeder elements for the EISCAT VHF parabolic cylinder antenna.
EISCAT Technical Notes No. 78/8, 1978.

H-J. Alker:
Program CORRSIM: System for program development and software simulation of EISCAT digital correlator, User's Manual.
EISCAT Technical Notes No. 79/9, 1979.

H-J. Alker:
Instruction manual for EISCAT digital correlator.
EISCAT Technical Notes No. 79/10, 1979

H-J. Alker:
A programmable correlator module for the EISCAT radar system.
EISCAT Technical Notes No. 79/11, 1979.

T. Ho and H-J. Alker:
Scientific programming of the EISCAT digital correlator.
EISCAT Technical Notes No. 79/12, 1979.

S. Westerlund (editor):
Proceedings EISCAT Annual Review Meeting 1969. Part I and II,
Abisko, Sweden, 12-16 March 1979.
EISCAT Meetings No. 79/3, 1979.

J. Murdin:
EISCAT UHF Geometry.
EISCAT Technical Notes No. 79/13, 1979.

T. Hagfors:
Transmitter Polarization Control in the EISCAT UHF System.
EISCAT Technical Notes No. 79/14, 1979.

B. Törustad:
A description of the assembly language for the EISCAT digital correlator.
EISCAT Technical Notes No. 79/15, 1979.

J. Murdin:
Errors in incoherent scatter radar measurements.
EISCAT Technical Notes No. 79/16, 1979.

EISCAT Digital Correlator. TEST MANUAL.
EISCAT Technical Notes No. 79/17, 1979.

G. Lejeune:
A program library for incoherent scatter calculation.
EISCAT Technical Notes No. 79/18, 1979.

K. Folkestad:
Lectures for EISCAT Personnel, Volume I
EISCAT Technical Notes No. 79/19, 1979.

Svein A. Kvalvik:
Correlator Buffer-Memory for the EISCAT Radar system
EISCAT Technical Notes. No. 80/20.

P-S. Kildal:
EISCAT VHF Antenna Tests
EISCAT Technical Notes No. 80/21

J. Armstrong:
EISCAT Experiment Preparation Manual
EISCAT Technical Notes No. 80/22

A. Farmer:
EISCAT Data Gathering and Dissemination
EISCAT Technical Note 80/23

Terrance Ho and Hans-Jørgen Alker:
Scientific Programming of the EISCAT Digital Correlator (Revised)
EISCAT Technical Note 81/24

Terrance Ho:
Programs Corrsim, Corrtest: System for Program Development and
Software Simulation of EISCAT Digital Correlator. User´s manual.
EISCAT Technical Note 81/25

Terrance Ho:
Instruction Manual for EISCAT Digital Correlator (Revised).
EISCAT Technical Note 81/26

Terrance Ho:
Standard Subroutines and Programs for EISCAT Digital Correlator.
EISCAT Technical Note 81/27

Terrance Ho:
Pocket Manual for Programming the EISCAT Digital Correlator.
EISCAT Technical Note 81/28

K. Folkestad:
Lectures for EISCAT Personnel, Volume II.
EISCAT Technical Note 81/29

M. Lehtinen och Anna-Liisa Turunen:
EISCAT UHF antenna direction calibration
EISCAT Technical Note 81/30

K. Folkestad:
Use of the EISCAT Radar as a supplement to rocket measurements.
EISCAT Technical Note 81/31

T. Turunen, T Mustonen and P J S Williams:
EISCAT UHF RECEIVERS: Report and Recommendations
EISCAT Technical Note 81/32

Phil Williams:
Polarisers in the EISCAT System
EISCAT Technical Note 81/33