Cyclization of Aryl Acyl Radicals Generated from S-(4-Cyano)phenyl Thioesters by a Nickel Complex Catalyzed Electroreduction

Shigeko Ozaki,* Masashi Adachi, Sayaka Sekiya, Rie Kamikawa

2-(Prop-2-enyl)benzoic acid (Method A): colorless oil; ^1H NMR (300 MHz) δ 3.83 (2H, d, J = 6.4, ArCH_2), 5.00-5.07 (2H, m, $\text{CH}=\text{CH}_2$), 5.98-6.11 (1H, m, $\text{CH}=\text{CH}_2$), 7.28-7.34 (2H, m, ArH), 7.50 (1H, td, J = 1.4, 7.5, ArH), 8.04 (1H, dd, J = 1.4, 8.0, ArH).

5-Methoxy-2-(prop-2-enyl)benzoic acid (Method B): yellow oil; ^1H NMR (300 MHz) δ 3.76 (2H, d, J = 6.4, ArCH_2), 3.84 (3H, s, OCH_3), 4.97-5.05 (2H, m, $\text{CH}=\text{CH}_2$), 5.96-6.09 (1H, m, $\text{CH}=\text{CH}_2$), 7.06 (1H, dd, J = 2.8, 8.4, ArH), 7.21 (1H, d, J = 8.6, ArH), 7.57 (1H, d, J = 2.9, ArH).

2-(3-Ethoxycarbonylprop-2-enyl)benzoic acid (Method C): orange oil; ^1H NMR (300 MHz) δ 1.26 (3H, t, J = 7.1, CH_3), 3.98 (2H, dd, J = 1.5, 6.4, ArCH_2), 4.16 (2H, q, J = 7.1, OCH_2), 5.75 (1H, dt, J = 1.6, 15.5, $\text{CH}=\text{CHCO}_2\text{Et}$), 7.16 (1H, dt, J = 6.5, 15.7, $\text{CH}=\text{CHCO}_2\text{Et}$), 7.28-7.55 (3H, m, ArH), 8.10 (1H, dd, J = 1.4, 7.8, ArH).

S-(4-Cyano)phenyl 2-(but-2-enyl)benzenethioate (1b): white solid; mp 88-90 $^\circ\text{C}$; ^1H NMR (300 MHz) δ 1.65 (3H, d, J = 5.8, $\text{CH}_3\text{CH}=\text{}$), 3.51 (2H, d, J = 6.0, ArCH_2), 5.41–5.60 (2H, m, $\text{CH}=\text{CH}$), 7.33 (2H, t, J = 7.3, ArH), 7.49 (1H, t, J = 7.5, ArH), 7.63 (2H, d, J = 8.2, $\text{Ar}'\text{H}$), 7.73 (2H, d, J = 8.2, $\text{Ar}'\text{H}$), 7.86 (1H, d, J = 7.5, ArH); ^{13}C NMR (75.5 MHz) δ 17.8, 36.3, 112.8, 113.7, 126.1, 126.7, 128.3, 128.9, 130.9, 132.4, 136.0, 140.2, 190.0; IR (nujol) ν_{max} 764, 905, 963, 1216, 1590, 1680 ($\text{SC}=\text{O}$), 2230 ($\text{C}\equiv\text{N}$) cm^{-1} ; FABMS m/e 294 ($\text{M}^+\text{+H}$); FABHRMS m/e 294.0975 ($\text{C}_{18}\text{H}_{16}\text{NOS}$ requires 294.0952).

Ethyl 4-{2-[(4-cyanophenyl) thiocarbonyl]phenyl}-2-butenate (1c): Inseparable mixtures of two rotamers. white solid; mp 85-86 $^\circ\text{C}$; ^1H NMR (300 MHz) major rotamer δ 1.26 (3H, t, J = 7.1, CH_3 , overlapped with those of the minor rotamer), 3.24 (2H, dd, J = 1.4, 7.0, C4-H_2), 4.15 (2H, q, J = 7.1, OCH_2 , overlapped with those of the minor rotamer), 6.30 (1H, dt, J = 7.1, 15.7, C2-H), 6.95 (1H, d, J = 15.7, C3-H), 7.29-7.43 (1H, m, ArH , overlapped with those of the minor rotamer), 7.53 (1H, t, J = 7.3, ArH , overlapped with those of the minor rotamer), 7.61-7.66 (3H, m, 1 x ArH + 2 x $\text{Ar}'\text{H}$, overlapped with those of the minor rotamer), 7.74 (2H, d, J = 8.6, $\text{Ar}'\text{H}$, overlapped with those of the minor rotamer), 7.91 (1H, dd, J = 1.2, 7.8, ArH); minor rotamer δ 3.74 (2H, dd, J = 1.4, 6.5, C4-H_2), 5.71 (1H, dt, J = 1.6, 15.7, C2-H), 7.06 (1H, dt, J = 6.5, 15.5, C3-H), 7.97 (1H, dd, J = 1.2, 7.8, ArH) (the peaks of other twelve protons overlapped with those of the major rotamer); ^{13}C NMR (75.5 MHz) δ 14.0, 14.1, 35.9, 38.2, 60.1, 60.7, 112.9, 113.0, 118.1, 122.4, 125.9, 127.1, 127.4, 127.5, 128.5, 128.9, 130.3, 131.5, 132.3, 132.4, 132.6, 132.9, 134.1, 134.4, 134.5, 134.9, 135.0, 135.8, 136.2, 137.0, 146.3, 166.1, 171.1, 189.8, 189.9; IR (nujol) ν_{max} 763, 832, 903, 965, 1158, 1200, 1213, 1268, 1680 ($\text{SC}=\text{O}$), 1725 (ester $\text{C}=\text{O}$), 2230 ($\text{C}\equiv\text{N}$) cm^{-1} ; Anal. Calcd for $\text{C}_{20}\text{H}_{17}\text{NO}_3\text{S}$: C, 68.36; H, 4.89; N, 3.98; S, 9.11. Found: C, 68.16; H, 4.91; N, 3.94; S, 9.03.

S-(4-Cyano)phenyl 5-methoxy-2-(prop-2-enyl)benzenethioate (1d): white solid; mp 44-45 °C; ¹H NMR (300 MHz) δ 3.51 (2H, d, *J* = 6.4, ArCH₂), 3.87 (3H, s, OCH₃), 4.92–5.04 (2H, m, CH=CH₂), 5.85–5.98 (1H, m, CH=CH₂), 7.03 (1H, dd, *J* = 2.6, 8.4, ArH), 7.24 (1H, d, *J* = 2.9, ArH), 7.38 (1H, d, *J* = 2.7, ArH), 7.63 (2H, d, *J* = 8.3, Ar'H), 7.73 (2H, d, *J* = 8.2, Ar'H); ¹³C NMR (75.5 MHz) δ 36.6, 55.5, 112.9, 113.8, 115.7, 118.0, 118.1, 130.8, 132.3, 132.4, 134.5, 134.9, 136.90, 136.93, 157.8, 189.9; IR (nujol) ν_{max} 826, 938, 1040, 1253, 1282, 1690 (SC=O), 2225 (C≡N) cm⁻¹; EIMS *m/e* 309 (M⁺), 175 (M⁺-SAr); EIHRMS *m/e* 309.0817 (C₁₈H₁₅NO₂S requires 309.0823).

Ethyl 5-{2-[(4-cyanophenyl)thiocarbonyl]phenyl}-2-pentenoate (1e): white solid; 60-62 °C; ¹H NMR (300 MHz) δ 1.27 (3H, t, *J* = 7.1, CH₃), 2.45-2.53 (2H, m, C4-H₂), 2.96 (2H, t, *J* = 7.3, C5-H₂), 4.16 (2H, q, *J* = 7.1, OCH₂), 5.79 (1H, dt, *J* = 1.4, 15.5, C2-H), 6.96 (1H, dt, *J* = 6.8, 15.5, C3-H), 7.28-7.39 (2H, m, ArH), 7.48-7.60 (1H, m, ArH), 7.64 (2H, d, *J* = 8.4, Ar'H), 7.75 (2H, d, *J* = 8.6, Ar'H), 7.94 (1H, dd, *J* = 1.2, 7.7, ArH); ¹³C NMR (75.5 MHz) δ 13.8, 31.7, 33.4, 59.7, 112.6, 117.7, 121.6, 126.3, 128.5, 130.8, 132.1, 132.3, 132.4, 134.6, 135.5, 139.9, 147.1, 165.9, 189.6; IR (nujol) ν_{max} 836, 907, 1157, 1203, 1262, 1320, 1680 (SC=O), 1720 (ester C=O), 2230 (C≡N) cm⁻¹; FABMS *m/e* 366 (M⁺+H); FABHRMS *m/e* 366.1165 (C₂₁H₂₀NO₃S requires 366.1164).

S-(4-Cyano)phenyl 2-(but-3-enyl)benzenethioate (1f): white solid; mp 79-80 °C; ¹H NMR (300 MHz) δ 2.35 (2H, q, *J* = 7.6, CH₂CH=), 2.91 (2H, t, *J* = 7.7, ArCH₂), 4.94-5.03 (2H, m, CH=CH₂), 5.75-5.89 (1H, m, CH=CH₂), 7.30-7.36 (2H, m, ArH), 7.49 (1H, t, *J* = 7.4, ArH), 7.64 (2H, d, *J* = 8.6, Ar'H), 7.74 (2H, d, *J* = 8.6, Ar'H), 7.89 (1H, d, *J* = 7.7, ArH); ¹³C NMR (75.5 MHz) δ 32.9, 35.3, 112.9, 115.1, 118.1, 126.1, 128.6, 131.1, 132.3, 132.4, 134.7, 134.9, 136.0, 137.5, 141.1, 190.0; IR (nujol) ν_{max} 760, 800, 1210, 1483, 1680 (SC=O), 2230 (C≡N) cm⁻¹; Anal. Calcd for C₁₈H₁₅NOS: C, 73.70; H, 5.16; N, 4.77; S, 10.91. Found: C, 73.72; H, 5.29; N, 4.78; S, 10.82.

C:\WINNR95\COMMON_DEFAULT ALS

IDFILE
 COMNT
 DATIM Mon Nov 12 17 54 48 2001
 OBNUC 1H
 EXMOD NON
 OBFRQ 300 40 MHz
 OBSET 130 00 KHz
 OBFIN 1150 0 Hz
 POINT 32768
 FREQU 6013 2 Hz
 SCANS 16
 ACQTM 5 449 sec
 PD 1 551 sec
 PM1 5 8 us
 IRNUC 1H
 CTEMP 24 2 C
 SLVNT CDCL3
 EXREF 0 00 ppm
 BF 0 12 Hz
 RGAIN 22

C:\WINNR95\TEMPDATA\AUTO1BCM_E1

COMPT
DATIM Fx1 Feb 15 10 10 36 2002
OBNUC 13C
EXMOD BCM
OBFRQ 75 45 MHz
OBSET 124 00 KHz
OBFIN 1840 0 Hz
POINT 32768
FREQ 20408 1 Hz
SCANS 480
ACQTM 1 606 sec
PD 1 394 sec
FW 4 0 us
IRNUC 1H
CTEMP 20 5 C
SIVNT CDCL3
EXREF 77 00 ppm
BF 1 20 Hz
RGAIN 24

6

RE
 C:\WINNR95\COMMON_DEFAULT ALS
 COMNT RE
 DATIM Mon Jan 07 15 38 58 2002
 OBNUC 1H
 EXMOD NON
 OBPRQ 300 40 MHz
 OBSET 130 00 KHz
 OBFIN 1150 0 Hz
 POINT 32768
 FREQU 6013 2 Hz
 SCANS 16
 ACQTM 5 449 sec
 PD 1 551 sec
 PW1 5 8 us
 IRNUC 1H
 CTENP 23 3 c
 SLVNT CDCL3
 EXREF 7 24 ppm
 BF 0 12 Hz
 RGAIN 23

C:\WINNR95\TEMPDATA\AUTO1BCM_E1

DFILE
COUNT
DATE Tue Nov 12 15 29 50 2002
OBNUC 13C
EXMOD BCM
OBFRQ 75 45 MHz
OBSET 124 00 KHz
OBFIN 1840 0 Hz
POINT 32768
FREQ 20408.1 Hz
SCANS 1000
ACQTM 1 606 sec
PD 1 394 sec
FW 4 3 us
IRNUC 1H
CTEMP 25 3 C
SOLVENT CDCL3
EXREF 77 00 ppm
BF 1 20 Hz
RGAIN 24

TS435-c

DFILE C:\WINMR95\TEMPDATA\AUTO1\BCM_E1
 COMMT TS435-c
 DATIM Sat Jun 08 16 57 58 2002
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75 45 MHz
 OBSET 124 00 KHz
 OBFIN 1840 0 Hz
 POINT 32768
 FREQU 20408 1 Hz
 SCANS 1040
 ACQTM 1 606 sec
 PD 1 394 sec
 FW 4 0 us
 IRNUC 1H
 CTMP 20 2 c
 SLVNT CDCL3
 EXREF 77 00 ppm
 BF 1 20 Hz
 RGAIN 24

```

DEFILE C:\WINMR95\COMMON\DEFAULT.ALS

```

COMPT. DATIM Thu Feb 28 18 40 42 2002

1H	OBNUC	300	40	MHz
1H	OBXMOD	130	00	KHz
1H	OBFRQ	1150	00	Hz
1H	OBSET	32768		POINT
1H	OBST	6013	2	Hz
1H	OBNUC	16		
1H	OBXMOD	5	449	sec
1H	OBFRQ	1	551	sec
1H	OBSET	5	8	us
1H	OBST	25	4	C
1H	OBNUC	0	00	ppm
1H	OBXMOD	0	12	Hz
1H	OBFRQ	21

DFILE C:\WINNMR95\TEMPDATA\AUTO1\BCM_E1

COMNT
 DATIM Fri Mar 01 12 34 50 2002
 OBNUC 13C
 EXMOD BCM

OBFREQ 75 45 MHz
 OBSSET 124 00 KHz
 OBFIN 1840 0 Hz
 POINT 32768
 FREQU 20408 1 Hz
 SCANS 380
 ACQTM 1 606 sec
 PD 1 394 sec
 PW1 4 0 us
 IRNUC 1H
 CTEMP 26 7 c
 SLVNT CDCL3
 EXREF 77 00 ppm
 BF 1 20 Hz
 RGAIN 24

C:\WINNMR95\COMMON\DEFAULT ALS

DFILE COMNT
 DATIM Wed Aug 14 16 32 57 2002
 OBNUC 1H
 EXMOD NON
 OBFRQ 300 40 MHz
 OBSET 130 00 KHz
 OBFIN 1150 0 Hz
 POINT 32768
 FREQU 6013 2 Hz
 SCANS 16
 ACQTM 5 449 sec
 PD 1 551 sec
 PW1 5 5 us
 IRNUC 1H
 CTMP 22 3 C
 SLVNT CDCL3
 EXREF 0 00 ppm
 BF 0 12 Hz
 RGAIN 18

C:\WINNER95\TEMPDATA\AUTO1BCM_E1

DFILE COMNT
 DATIM Mon Aug 19 12 48 07 2002
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75 45 MHz
 OBSET 124 00 KHz
 OBFIN 1840 0 Hz
 POINT 32768
 FREQU 20408 1 Hz
 SCANS 800
 ACQTM 1 606 sec
 PD 1 394 sec
 PM1 4 3 us
 INNUC 1H
 CTEMP 21 1 C
 SLVNT CDCl3
 EXREF 77 00 ppm
 BF 1 20 Hz
 RGAIN 24

C:\WINNR95\COMMON_DEFAULT.ALS

DETLE
 COMNT
 DATIM
 OBNUC
 EXMOD
 OBFRQ
 OBSFQ
 OBSFT
 OBSFN
 POINT
 FREQU
 SCANS
 ACQTM
 PD
 PW1
 IRNUC
 CTEMP
 SIVNT
 EXREF
 BF
 RGAIN

Thu Oct 24 20 36 51 2002
 1H
 NON

300 40 MHz
 130 00 KHz
 1150 0 Hz
 32768
 6013 2 Hz
 16
 5 449 sec
 1 551 sec
 5 5 us
 1H
 24 8 C
 CDCL3
 0 00 ppm
 0 12 Hz
 23

C:\WINNMR95\COMMON\DEFAULT ALS

DTITLE
 CONNT
 DATIM Thu Feb 14 18 30 24 2002
 OBNUC 1H
 EXMOD NON
 OBFREQ 300.40 MHz
 OBSET 130.00 KHz
 OBEIN 1150.0 Hz
 POINT 32768
 FREQU 601.32 Hz
 SCANS 8
 ACQTM 5.449 sec
 PD 1.551 sec
 PW1 5.8 us
 IRNUC 1H
 CTEMP 22.3 C
 SIVNT CDCL3
 EXREF 0.00 ppm
 BF 0.12 Hz
 RGAIN 14

C:\WINNMR95\TEMPDATA\AUTO1BCM_E1

Thu Feb 14 18 57 45 2002

DFILE COMMT
 DATIM
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75 45 MHz
 OBSET 124 00 KHz
 OBFET 1840 0 Hz
 POINT 32768
 FREQU 20408 1 Hz
 SCANS 480
 ACQTM 1 606 sec
 PD 1 394 sec
 PW1 4 0 us
 IRNUC 1H
 CTMP 23 2 C
 CDCL3
 SLVNT
 EXREF 77 00 ppm
 BF 1 20 Hz
 RGAIN 25

C:\WINNR95\COMMON\DEFAULT\ALS

DFILE
COMNT
DATIM
OBNUC
EXMOD
OBFREQ
OBFREQ
OBFREQ
OBFREQ
POINT
FREQ
SCANS
ACQTM
PD
PW1
IRNUC
CTEMP
SLVNT
EXREF
BF
RGAIN

Thu Nov 14 18 56 00 2002

1H
NON
300 40 MHz
130 00 KHz
1150 0 Hz
32768
6013 2 Hz
16
5 449 sec
1 000 sec
5 5 us
1H
23 9 C
CDCL3
0 00 ppm
0 12 Hz
23

C:\WINNR95\COMMON_DEFAULT ALS

DFILE COMPT
 DATIM Fri Jun 21 09 37 39 2002
 EXMOD 1H
 OBNUC NON
 OBFRQ 300 40 MHz
 OBSFQ 130 00 KHz
 OBSIN 1150 0 Hz
 POINT 32768
 FREQU 6013 2 Hz
 SCANS 16
 ACQTM 5 449 sec
 PD 1 551 sec
 PW1 5 8 us
 IRNUC 1H
 CTEMP 21 3 C
 SLVNT CDCL3
 EXREF 0 00 ppm
 BF 0 12 Hz
 RGAIN 25

C:\WINNR95\TEMPDATA\AUTO1BCM_E1

DFILE COMNT
 DATIM F1 Jun 21 12 38 47 2002
 OBNUC 13C
 EXMOD BCM
 OBFREQ 75 45 MHz
 OBSSET 124 00 KHz
 OBFIN 1840 0 Hz
 POINT 32768
 FREQU 20408.1 Hz
 SCANS 640
 ACQTM 1 606 sec
 PD 1 394 sec
 FW1 4 0 us
 IRNUC 1H
 CTEMP 20 7 C
 SLYNT CDCL3
 EXREF 77 00 ppm
 BF 1 20 Hz
 RGAIN 24

C:\WINNMR95\COMMON\DEFAULT ALS

COMPT Wed Mar 06 20 08 24 2002

DATIM 1H

OBNUC 1H

EXMOD NON

OBFRQ 300 40 MHz

OBSET 130 00 KHz

OBEIN 1150 0 Hz

POINT 32768

FREQU 6013 2 Hz

SCANS 16

ACQTM 5 449 sec

PD 1 551 sec

PW1 5 8 us

IRNUC 1H

CTEMP 24 1 c

SLVNT CDCL3

EXREF 0 00 ppm

BF 0 12 Hz

RGAIN 15

DFILE C:\WINNR95\TEMPDATA\AUTO1BCM_E1

COMMIT
 DATIM Thu Mar 07 10 33 55 2002
 ORNUC 13C
 EXMOD BCM

OBFRQ 75 45 MHz
 OBSET 124 00 KHz
 OFIN 1840 0 Hz
 POINT 32768
 FREQU 20408 1 Hz
 SCANS 760

ACQTM 1 606 sec
 PD 1 394 sec
 FW 4 0 us

IRNUC 1H
 CTEMP 25 1 C
 SLVNT CDCL3
 EXREF 77 00 ppm
 BF 1 20 Hz
 RGAIN 24

DFILE: C:\WINNR95\COMMON\DEFAULT ALS

COMPT Thu Aug 22 19 11 36 2002

OBNUC 1H

EXMOD NON

OBFRQ 300 40 MHz

OBSET 130 00 KHz

OBFIN 1150 0 Hz

POINT 32768

FREQU 6013 2 Hz

SCANS 16

ACQTM 5 449 sec

PD 1 551 sec

PW1 5 5 us

IRNUC 1H

CTEMP 21 8 C

SLVNT CDCL3

EXREF 0 00 ppm

BF 0 12 Hz

RGAIN 22

C:\WINNR95\TEMPDATA\AUTO1BCM_E1
 DEFILE
 COMMT
 DATIM Thu Aug 22 14 42 02 2002
 OBNUC 13C
 EXMOD BCM
 OBFRQ 75 45 MHz
 OBSET 124 00 KHz
 OBFIN 1840 0 Hz
 POINT 32768
 FREQU 20408 1 Hz
 SCANS 840
 ACQTM 1 606 sec
 PD 1 394 sec
 PW1 4 3 us
 INUC 1H 21 6 c
 CTEMP CDCL3
 SLVMT 77 00 ppm
 EXREF 1 20 Hz
 BF 25
 RGAIN

DFILE C:\WINNMR95\COMMON_DEFAULT_ALS

COMPT a
 DATIM Mon Oct 28 16 09 57 2002

OBNUC 1H
 EXMOD NON
 OBFRQ 300 40 MHz
 OBSET 130 00 KHz
 OBFIN 1150 0 Hz
 POINT 32768
 FREQU 6013 2 Hz
 SCANS 16
 ACQTH 5 449 sec
 PD 1 551 sec
 FWH 5 5 us
 IRNUC 1H
 CTMP 25 0 c
 SLVNT CDCL3
 EXREF 0 00 ppm
 BF 0 12 Hz
 RGAIN 20

C:\WINNMR95\TEMPDATA\AUTO1BCM_E1

DFILE COMNT
DATIM Tue Oct 29 12 41 59 2002
OBNUC 13C
EXMOD BCM
OBPRO 75 45 MHz
OBSET 124 00 KHz
OBFIN 1840 0 Hz
POINT 32768
FREQ 20408 1 Hz
SCANS 940
AQTM 1 606 sec
PD 1 394 sec
PWL 4 3 us
IRNUC 1H
CTEMP 24 9 C
SIVNT CDCL3
EXREF 77 00 ppm
BF 1 20 Hz
RGAIN 24

C:\WINNMR95\COMMON_DEFAULT ALS

COMMIT e
 DATIM Wed Nov 21 14 36 55 2001

OBNUC 1H
 EXMOD NON

OBFRQ 300 40 MHz

OBSET 130 00 KHz

OBFIN 1150 0 Hz

POINT 32768

FREQU 6013 2 Hz

SCANS 16

ACQTM 5 449 sec

PD 1 551 sec

PW1 5 8 us

IRNUC 1H

CTEMP 23 4 C

SLVNT CDCL3

EXREF 0 00 ppm

BF 0 12 Hz

RGAIN 18

4a

DFILE C:\WINNR95\COMMON_DEFAULT ALS

COMNT Tue Mar 05 16 20 58 2002

OBNUC 1H

EXMOD NON

OBFRQ 300 40 MHz

OBSET 130 00 KHz

OBFIN 1150 0 Hz

POINT 32768

FREQU 6013 2 Hz

SCANS 16

ACQTM 5 449 sec

PD 1 551 sec

FW1 5 8 us

IRNUC 1H

CTEMP 24 1 C

SIVNT CDCL3

EXREF 0 00 ppm

BF 0 12 Hz

RGAIN 25

C:\WINNMR95\COMMON_DEFAULT\ALS
 DEFILE

COMMENT
 DATIM Wed Oct 30 18 45 59 2002

OBNUC 1H

EXMOD NON

OBFRQ 300 40 MHz

OBSET 130 00 KHz

OBFIN 1150 0 Hz

POINT 32768

FREQU 6013 2 Hz

SCANS 16

ACQTM 5 449 sec

PD 1 551 sec

PW1 5 5 us

IRNUC 1H

CTMP 25 8 c

SILVT CDCL3

EXREF 0 00 ppm

BF 0 12 Hz

RGAIN 21

yellow cap

DFFILE C:\WINMR95\COMMON_DEFAULT A
COMNT yellow cap
DATIM Mon Jun 17 17 48 20 2002
OBNUC 1H
EXMOD NON
OBFRQ 300 40 MHz
OBSET 130 00 KHz
OBFIN 1150 0 Hz
POINT 32768
FREQU 6013 2 Hz
SCANS 16
ACQTM 5 449 sec
PD 1 551 sec
PW1 5 8 us
IRNUC 1H
CTEMP 20 3 C
SLVNT CDCL3
EXREF 0 00 ppm
BF 0 12 Hz
RGAIN 24