Microwave Spectra of Molecules of Astrophysical Interest
IX. Acetaldehyde

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The microwave spectrum of acetaldehyde is critically reviewed and augmented through calculations which include the effects of internal rotation and centrifugal distortion. Since the primary objective of this review is to provide microwave spectral transitions applicable to radio astronomy studies, the review encompasses only the ground state rotational spectrum of the most abundant isotopic form of acetaldehyde, $^{12}CH_3^{12}CH^{16}O$. While all measured transitions are included, the predicted transition frequencies were limited to $J \leq 12$ in the range of 900 MHz to 250 GHz. In addition to this spectral information, the review includes the rotational constants, centrifugal distortion constants, inertial rotation parameters, electric dipole moment, structural data, moments of inertia, and constants relating to the barrier to internal rotation.

Key words: Acetaldehyde; internal rotation; interstellar molecules; microwave spectrum; radio astronomy; rotational transitions.

Contents

1. Introduction

The present work is the ninth part of a series of critical reviews [1–8] [1] which are intended to update, revise, and augment the existing literature on molecules identified in interstellar molecular clouds. The spectral information provided includes predicted and observed rotational transitions between 900 MHz and 250 GHz. The predicted transitions are limited to those between rotational levels with $J \leq 12$. We estimate that radiative relaxation from higher rotational levels will generally be much faster than the collisional excitation rates which have been derived for the interstellar molecular clouds in which large organic molecules, like acetaldehyde, have been observed. Spectral data on the less abundant isotopic forms and for excited vibrational states of acetaldehyde have not been included in this review; however, the references provided in section 3.1.b cover all of the relevant literature.

2. Organization of Tables

The predicted rotational spectrum of acetaldehyde presented in tables 4 and 5 is based almost entirely on new laboratory measurements. The open literature has been searched for additional information relating to the microwave spectrum of acetaldehyde and all pertinent data has been summarized in the molecular parameter 76 spectral tables.

2.1. Molecular Parameter Tables

The rotational constants, centrifugal distortion constants, and internal rotation parameters in table 1 were obtained from a nonlinear least-squares fit of measured transition frequencies in the vibrational and torsional ground state of acetaldehyde ($^{12}CH_3{}^{12}CH^{16}O$) [9]. The internal axis method (IAM) [10] was selected for the calculation of transition frequencies of a rotating molecule with a symmetric internal rotor. Woods [11] presented a convenient scheme for this calculation and introduced suitable approximations for the high barrier

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[1] Numbers in brackets indicate references in section 2.4.

limit. Besides the diagonal contribution from the internal rotation problem to the over-all rotation only off-diagonal elements between two near degenerate states in the prolate representation were allowed for and diagonalized in a two-by-two subspace. The program of Woods [11] was modified and extended by the inclusion of the centrifugal distortion correction for a nonplanar asymmetric rotor in the form given by Watson [12]. However, centrifugal distortion due to internal rotation was completely neglected. Finite differences of transition frequencies were calculated for individual variations of all eleven molecular parameters. These parameters were simultaneously adjusted in the least-squares fit using 99 measured transition frequencies up to $J=12$. The iterations were stopped when the sum of square deviation between measured and calculated frequencies did not decrease further. Standard deviations given in table 1 and correlation coefficients given in table 2 were calculated for all parameters.

The dipole moment components in table 1 were taken directly from the literature cited. The parameters which were fitted primarily to the measured transition frequencies were transformed to alternative physical constants for the over-all rotation and internal rotation problem of acetaldehyde. The results are collected in table 3. The structural parameters were taken again directly from the literature cited.

2.2. Microwave Spectral Tables

Tables 4 and 5 contain the results of the statistical analysis of the rotational spectrum of acetaldehyde ($^{12}CH_3{}^{12}CH^{16}O$). For each spectral line the first columns of tables 4 and 5 contain the quantum numbers of the upper and lower state in the form J, K_-, K_+ for the asymmetric rotor plus a symmetry label S for the internal rotation substate. The quantum numbers are followed by the observed transition frequency in the vibrational and torsional ground state and the experimentally estimated uncertainty in MHz. In the next column the calculated transition frequencies are listed which were evaluated from the molecular parameters of table 1. The calculated transition frequencies are followed by their calculated uncertainties. The latter are twice the standard deviations from the least-squares analysis and represent approximately 95 percent confidence levels. The standard deviations were calculated from finite differences of transition frequencies upon variations of molecular parameters and the variance-covariance matrix as described by Kirchhoff [13]. The next column shows the calculated relative intensity of the torsionally allowed transitions. The product of the rigid rotor line strength, ${}^xS_{J';J''}$ and the square of the dipole moment component, μ_x^2, for the rotational transitions are shown in the next column.

The total line strength was calculated approximately as the product of the relative intensity of the torsionally allowed transitions and of the corresponding product $\mu^2_x{}^xS_{J';J''}$. The absolute nuclear spin-statistical weight factors were suppressed. Spectral lines were omitted from the tables for total line strengths below 0.001. The rigid rotor line strength is calculated as the expectation value of the electric dipole transition moment for polarized microwave radiation

$$|\langle J', K'_-, K'_+|\mu_Z|J'', K''_-, K''_+\rangle|^2 = \sum_{M'} |\langle J', K'_-, K'_+, M'|\mu_Z|J'', K''_-, K''_+, M''\rangle|^2 = \mu_x^2{}^xS(J', K'_-, K'_+; J'', K''_-, K''_+),$$

where the subscript Z refers to the direction of polarization and the superscript x to the a or b principal axis and μ_x represents the corresponding dipole moment component [14]. Thus, the line strengths as defined clearly depend on the absolute magnitude of the dipole moment. The total line strength may be related to the Einstein coefficient, A, in the following manner. The probability, $A(J', K'_-, K'_+, S; J'', K''_-, K''_+, S)$, of a spontaneous transition in one second from the upper state J', K'_-, K'_+, S to the lower state J'', K''_-, K''_+, S is

$$A(J', K'_-, K'_+, S; J'', K''_-, K''_+, S) = 1.1639\times10^{-20}\nu^3|\langle J', K'_-, K'_+, S|\mu_Z|J'', K''_-, K''_+, S\rangle|^2/(2J'+1),$$

where ν is the transition frequency in MHz and $|\langle J', K'_-, K'_+, S|\mu_Z|J'', K''_-, K''_+, S\rangle|^2$ the total line strength.

The total rotational and torsional energy of upper and lower state are shown in the last two columns. These energies are given in cm^{-1}. The torsional zero-point energy of 74.2 cm^{-1} [9] with respect to the minimum of the potential barrier was subtracted from all energy levels.

As a convenience to the user the calculated transition frequencies from tables 4 and 5 have been listed according to increasing frequency in table 6. Additional rotational transitions were assigned with J values ranging up to 23 [9]. They were, however, not included in the least-squares analysis. They exhibited increasing systematic deviations due to the approximations introduced during the calculations. The measured frequencies of these additional transitions are collected in table 7.

2.3. List of Symbols and Conversion Factors

a. Symbols

A, B, C	Rotational constants (MHz). $A \geq B \geq C$. ($A = h/8\pi^2 I_a$, etc.).
I_a, I_b, I_c	Moments of inertia in the principal axes system (uÅ^2).
I_τ	Moment of inertia of the methyl top around internal rotation axis (uÅ^2).
Δ	Inertial defect (uÅ^2). $\Delta = I_c - I_a - I_b + I_\tau$.

a, b, c — Principal axes corresponding to I_a, I_b, I_c, respectively.

$\Delta_J, \Delta_{JK}, \Delta_K, \delta_J, \delta_K$ — Quartic centrifugal distortion constants (kHz) defined according to Watson [12].

ρ — Internal rotation interaction constant [11].

$$\rho = \left[\sum_x (\lambda_x I_\tau / I_x)^2 \right]^{1/2}.$$

β — Second Eulerian angle for transformation from the principal axes system to the internal rotational axes system [11].

Δ_0 — Internal rotation interaction constant (MHz). $\Delta_0 = 3Fa_1(s)/2 =$ energy difference between $0(0,0)A$, and $0(0,0)E$ state [11].

$\lambda_a, \lambda_b, \lambda_c$ — Direction cosines between the internal rotation axis and the principal axes a, b, c, respectively.

φ — Angle between the internal rotation axis and the a principal axis.

τ — Angle around internal rotation axis.

F — Internal rotation dynamical constant [11]. $F = h/8\pi^2 r I_\tau$.

V_3 — Threefold component of torsional barrier potential (cm^{-1}). $V = V_3 (1 - \cos 3\tau)/2$.

s — Reduced barrier height. $s = 4V_3/9F$.

r — $r = 1 - \sum_x (\lambda_x^2 I_\tau / I_x)$.

$a_1(s)$ — Fourier coefficient [10].

μ_a, μ_b, μ_c — Components of the electric dipole moment along the principal axes (Debye).

D — Abbreviation for Debye units (1 D $= 10^{-18}$ electrostatic units of charge $\times$ cm $= 3.33564 \times 10^{-30}$ C·m).

J — Total rotational angular momentum quantum number.

K_- — Projection of J on the symmetry axis in the limiting prolate symmetric top.

K_+ — Projection of J on the symmetry axis in the limiting oblate top.

A, E — Torsional symmetry species, representing irreducible representations of the symmetry group of the rotation-internal rotation Hamiltonian.

$r(X-Y)$ — Distance between nuclei X and Y (Å).

$\angle XYZ$ — Angle formed by nuclei X, Y, and Z (degrees).

(. . . .) — Parentheses in the numerical listings contain measured or estimated uncertainties. These should be interpreted as: 1.409(0.083) = 1.409(83) = 1.409 ± 0.083.

b. Conversion Factors

The following conversion factors have been used:

$A \cdot I_a = 5.0537905(85) \times 10^5$ MHz·u·Å^2,
$h = 6.626176(36) \times 10^{-34}$ J·s,
$c = 2.99792458(1) \times 10^8$ m·s^{-1}
1 cm^{-1} $= 1.986478(11) \times 10^{-23}$ J,
$= 11.96266$ J·mol^{-1},
1 u $= 1.6605655(86) \times 10^{-27}$ kg,
1 Å $= 10^{-10}$ m.

2.4. References

[1] D. R. Johnson, F. J. Lovas, and W. H. Kirchhoff, J. Phys. Chem. Ref. Data **1**, 1011 (1972).
[2] W. H. Kirchhoff, D. R. Johnson, and F. J. Lovas, J. Phys. Chem. Ref. Data **2**, 1 (1973).
[3] R. M. Lees, F. J. Lovas, W. H. Kirchhoff, and D. R. Johnson, J. Phys. Chem. Ref. Data **2**, 205 (1973).
[4] P. Helminger, F. C. DeLucia, and W. H. Kirchhoff, J. Phys. Chem. Ref. Data **2**, 215 (1973).
[5] F. C. DeLucia, P. Helminger, and W. H. Kirchhoff, J. Phys. Chem. Ref. Data **3**, 211 (1974).
[6] A. Maki, J. Phys. Chem. Ref. Data **3**, 221 (1974).
[7] F. J. Lovas and P. H. Krupenie, J. Phys. Chem. Ref. Data **3**, 245 (1974).
[8] E. Tiemann, J. Phys. Chem. Ref. Data **3**, 259 (1974).
[9] A. Bauder and Hs. H. Günthard, to be published.
[10] C. C. Lin and J. D. Swalen, Rev. Mod. Phys. **31**, 841 (1959).
[11] R. C. Woods, J. Mol. Spectrosc. **21**, 4 (1966).
[12] J. K. G. Watson, J. Chem. Phys. **46**, 1935 (1967).
[13] W. H. Kirchhoff, J. Mol. Spectrosc. **41**, 333 (1972).
[14] C. H. Townes and A. L. Schawlow, *Microwave Spectroscopy* (McGraw Hill, New York) 1955.

3. Acetaldehyde Spectral Tables

Table 1. Molecular parameters for acetaldehyde ($^{12}CH_3{}^{12}CH^{16}O$).

Rotational constants[a] (MHz)	Ref. [75A]
A	56 609.474(537)
B	10 162.7664(875)
C	9 100.4121(864)
Distortion constants (kHz)	**Ref. [75A]**
Δ_J	7.6986(7293)
Δ_{JK}	0.9764(7.9215)
Δ_K	678.5932(51.2701)
δ_J	1.2216(1345)
δ_K	-135.3705(12.2858)
Internal rotation parameters	**Ref. [75A]**
ρ	0.329225(151)
β (rad)	0.081907(318)
Δ_0 (MHz)	-2 074.889(1.409)
Dipole moment (Debye)	**Ref. [57A]**
μ_a	2.55
μ_b	0.87

[a] The number of significant figures quoted are necessary to reproduce all the calculated frequencies within their standard deviations without round-off errors. See the list of symbols (section 2.3.a.) for interpretation of the standard deviations shown in parentheses.

Table 3. Additional molecular parameters for acetaldehyde ($^{12}CH_3{}^{12}CH^{16}O$).

Moments of inertia (uÅ ^{2})	Ref. [75A]
I_a	8.927464(86)
I_b	49.72849(44)
I_c	55.53364(54)
I_τ	3.22101
Δ	0.0987
Potential barrier to internal rotation	**Ref. [75A]**
λ_a	0.90943
λ_b	0.41585
φ (°)	24.573
s	23.445
F (GHz)	227.262
V_3 (cm^{-1})	399.9
Structural parameters	**Ref. [73A]**
r(C-C)	1.5005(14) Å
r(C-O)	1.2038(10) Å
r(C-H) aldehyde	1.1237(12) Å
r(C-H) in-plane methyl	1.0793(14) Å
r(C-H) out-of-plane methyl	1.1024(6) Å
∠CCO	124.72(17)°
∠CCH aldehyde	113.93(22)°
∠CCH in-plane methyl	110.68(10)°
∠CCH out-of-plane methyl	109.24(4)°
∠HCCO dihedral	120.88(5)°

Table 2. Correlation coefficients

	A	B	C	Δ_J	Δ_{JK}	Δ_K	δ_J	δ_K	ρ	Δ_0
B	.7780									
C	.8151	.8217								
Δ_J	.7228	.8598	.8503							
Δ_{JK}	.6564	.7899	.7400	.8290						
Δ_K	.4903	.1623	.3085	.3419	-.1174					
δ_J	.4514	.4437	.3598	.5475	.2774	.6103				
δ_K	-.3100	-.0419	-.4023	-.2835	-.0817	-.5726	-.6569			
ρ	-.0477	-.0031	.0246	-.0012	-.0098	.0161	.0827	-.1416		
Δ_0	.0161	.0432	-.0100	.0195	-.0256	.0994	.1655	-.1293	.4777	
β	.0318	-.0525	.0514	.0199	.0180	.0148	-.0776	-.0171	-.4095	-.7780

Table 4. The microwave spectrum for the A symmetry state of $^{12}CH_3{}^{12}CH^{16}O$

J' K'₋ K'₊ - J" K"₋ K"₊ S	Measured Transition Freq. Unc. (MHz)	Calculated Transition Freq. Unc. (MHz)	Line Strength Relative	Line Strength Rig.Rotor $\mu_x^2\ {}^xS_{J';J''}$	Line Strength Total	Energy Levels Upper (cm^{-1})	Energy Levels Lower (cm^{-1})	Ref.
1(0, 1) - 0(0, 0)A	19265.156(0.020)	19265.263(0.329)	1.000	6.502	6.502	0.643	0.000	75A
1(1, 1) - 0(0, 0)A		66022.804(1.218)	1.000	0.757	0.757	2.202	0.000	
1(1, 0) - 1(1, 1)A	1065.075(0.005)	1065.001(0.089)	1.000	9.754	9.754	2.238	2.202	73B
1(1, 0) - 1(0, 1)A		47822.542(0.985)	1.000	1.135	1.135	2.238	0.643	
2(0, 2) - 1(0, 1)A	38512.113(0.020)	38512.334(0.625)	1.000	13.004	13.004	1.927	0.643	75A
2(1, 1) - 1(1, 0)A	39594.287(0.020)	39594.343(0.604)	1.000	9.754	9.754	3.559	2.238	75A
2(1, 2) - 1(1, 1)A	37464.168(0.020)	37464.405(0.559)	1.000	9.754	9.754	3.452	2.202	75A
2(2, 0) - 1(0, 1)A		227556.929(3.740)	1.000	0.001	0.001	8.233	0.643	
2(2, 0) - 1(1, 1)A		180799.388(2.837)	1.000	1.122	1.122	8.233	2.202	
1(1, 1) - 2(0, 2)A	8243.482(0.020)	8245.207(0.687)	1.000	0.391	0.391	2.202	1.927	75A
2(1, 2) - 1(0, 1)A	84219.764(0.180)	84221.946(1.411)	1.000	1.135	1.135	3.452	0.643	75C
2(2, 1) - 1(1, 0)A		179716.386(2.825)	1.000	1.135	1.135	8.233	2.238	
2(1, 1) - 2(1, 2)A	3195.167(0.010)	3194.939(0.256)	1.000	5.419	5.419	3.559	3.452	74A
2(2, 1) - 2(0, 2)A		189026.594(3.278)	1.000	0.002	0.002	8.233	1.927	
2(1, 1) - 2(0, 2)A		48904.551(0.974)	1.000	1.871	1.871	3.559	1.927	
2(2, 0) - 2(1, 1)A		140140.044(2.410)	1.000	0.652	0.652	8.233	3.559	
2(2, 1) - 2(1, 2)A		143316.982(2.434)	1.000	0.631	0.631	8.233	3.452	
3(2, 1) - 2(2, 0)A		57861.883(0.615)	1.000	10.838	10.838	10.163	8.233	
3(0, 3) - 2(0, 2)A		57723.059(0.859)	1.000	19.503	19.503	3.853	1.927	
3(1, 2) - 2(1, 1)A		59379.590(0.820)	1.000	17.339	17.339	5.539	3.559	
3(1, 3) - 2(1, 2)A		56185.037(0.770)	1.000	17.339	17.339	5.326	3.452	
3(2, 2) - 2(2, 1)A		57789.918(0.610)	1.000	10.837	10.837	10.160	8.233	
3(2, 1) - 2(0, 2)A		246906.477(3.663)	1.000	0.004	0.004	10.163	1.927	
3(2, 1) - 2(1, 2)A		201196.865(2.813)	1.000	1.218	1.218	10.163	3.452	
3(0, 3) - 2(1, 2)A	12014.999(0.020)	12013.447(0.726)	1.000	0.800	0.800	3.853	3.452	75A
2(2, 1) - 3(1, 2)A		80742.454(1.990)	1.000	0.132	0.132	8.233	5.539	
3(1, 3) - 2(0, 2)A		101894.649(1.544)	1.000	1.522	1.522	5.326	1.927	
3(2, 2) - 2(1, 1)A		197911.961(2.778)	1.000	1.261	1.261	10.160	3.559	
2(2, 0) - 3(1, 3)A		87149.946(1.999)	1.000	0.123	0.123	8.233	5.326	
3(1, 2) - 3(1, 3)A		6389.492(0.481)	1.000	3.794	3.794	5.539	5.326	
3(2, 2) - 3(0, 3)A		189093.453(3.031)	1.000	0.007	0.007	10.160	3.853	
3(3, 0) - 3(2, 1)A		235685.603(5.503)	1.000	0.672	0.672	18.025	10.163	
3(1, 2) - 3(0, 3)A		50561.081(0.968)	1.000	2.574	2.574	5.539	3.853	
3(2, 1) - 3(1, 2)A		138622.337(2.219)	1.000	1.170	1.170	10.163	5.539	
3(2, 2) - 3(1, 3)A		144921.863(2.256)	1.000	1.094	1.094	10.160	5.326	
3(3, 1) - 3(2, 2)A		235775.378(5.492)	1.000	0.672	0.672	18.025	10.160	
4(2, 2) - 3(2, 1)A		77217.944(0.715)	1.000	19.507	19.507	12.739	10.163	
4(0, 4) - 3(0, 3)A		76879.462(1.006)	1.000	25.998	25.998	6.417	3.853	
4(3, 1) - 3(3, 0)A		77083.347(0.779)	1.000	11.380	11.380	20.596	18.025	
4(1, 3) - 3(1, 2)A		79150.260(0.944)	1.000	24.383	24.383	8.179	5.539	
4(3, 2) - 3(3, 1)A		77082.202(0.779)	1.000	11.380	11.380	20.596	18.025	
4(1, 4) - 3(1, 3)A		74892.050(0.904)	1.000	24.383	24.383	7.824	5.326	
4(2, 3) - 3(2, 2)A		77038.268(0.706)	1.000	19.507	19.507	12.730	10.160	
4(2, 2) - 3(1, 3)A		222229.772(2.697)	1.000	1.327	1.327	18.025	12.739	
3(3, 1) - 4(2, 2)A		158467.469(5.508)	1.000	0.096	0.096	18.025	12.739	
4(0, 4) - 3(1, 3)A	32709.185(0.020)	32707.873(0.846)	1.000	1.232	1.232	6.417	5.326	75A
3(2, 2) - 4(1, 3)A		59382.112(1.804)	1.000	0.301	0.301	10.160	8.179	
4(1, 4) - 3(0, 3)A	119061.400(0.160)	119063.640(1.603)	1.000	1.924	1.924	7.824	3.853	
4(2, 3) - 3(1, 2)A		215570.639(2.642)	1.000	1.423	1.423	12.730	5.539	
3(2, 1) - 4(1, 4)A		70119.778(1.800)	1.000	0.268	0.268	10.163	7.824	
3(3, 0) - 4(2, 3)A		158737.301(5.476)	1.000	0.096	0.096	18.025	12.730	
4(1, 3) - 4(1, 4)A	10648.428(0.020)	10647.701(0.734)	1.000	2.928	2.928	8.179	7.824	75A
4(2, 3) - 4(0, 4)A		189252.258(2.753)	1.000	0.017	0.017	12.730	6.417	
4(3, 1) - 4(2, 2)A		235551.006(5.200)	1.000	1.214	1.214	20.596	12.739	
4(1, 3) - 4(0. 4)A		52831.879(0.975)	1.000	3.232	3.232	8.179	6.417	
4(2, 2) - 4(1, 3)A		136690.020(2.012)	1.000	1.676	1.676	12.739	8.179	
4(2, 3) - 4(1, 4)A		147068.081(2.054)	1.000	1.503	1.503	12.730	7.824	
4(3, 2) - 4(2, 3)A		235819.312(5.168)	1.000	1.213	1.213	20.596	12.730	
5(4, 1) - 4(4, 0)A		96342.415(1.976)	1.000	11.705	11.705	34.795	31.581	
5(2, 3) - 4(2, 2)A	96632.550(0.250)	96632.192(0.773)	1.000	27.309	27.309	15.962	12.739	
5(0, 5) - 4(0, 4)A	95963.380(0.180)	95964.091(1.057)	1.000	32.488	32.488	9.618	6.417	
5(3, 2) - 4(3, 1)A	96371.600(0.125)	96370.821(1.044)	1.000	20.808	20.808	23.811	20.596	
5(1, 4) - 4(1, 3)A	98900.986(0.140)	98901.049(0.972)	1.000	31.208	31.208	11.478	8.179	
5(3, 3) - 4(3, 2)A	96368.050(0.250)	96366.817(1.044)	1.000	20.808	20.808	23.810	20.596	
5(1, 5) - 4(1, 4)A	93580.859(0.100)	93581.349(0.953)	1.000	31.208	31.208	10.946	7.824	

Table 4. The microwave spectrum for the A symmetry state of $^{12}CH_3{}^{12}CH^{16}O$—Continued

$J' K'_- K'_+ - J'' K''_- K''_+$ S	Measured Transition Freq. Unc. (MHz)	Calculated Transition Freq. Unc. (MHz)	Line Strength Relative	Rig.Rotor $\mu_x^2\ {}^xS_{J';J''}$	Total	Energy Levels Upper (cm^{-1})	Lower (cm^{-1})	Ref
5(4, 2) - 4(4, 1)A	96343.250(0.125)	96342.402(1.976)	1.000	11.705	11.705	34.795	31.581	
5(2, 4) - 4(2, 3)A	96274.200(0.125)	96273.805(0.766)	1.000	27.309	27.309	15.941	12.730	
5(2, 3) - 4(1, 4)A		243969.914(2.527)	1.000	1.423	1.423	15.962	7.824	
4(3, 2) - 5(2, 3)A		138917.479(5.209)	1.000	0.229	0.229	20.596	15.962	
5(0, 5) - 4(1, 4)A		53779.913(0.962)	1.000	1.693	1.693	9.618	7.824	
4(4, 1) - 5(3, 2)A		232948.756(15.470)	1.000	0.077	0.077	31.581	23.811	
4(2, 3) - 5(1, 4)A	37516.317(0.020)	37519.330(1.658)	1.000	0.492	0.492	12.730	11.478	75A
5(1, 5) - 4(0, 4)A		135765.526(1.596)	1.000	2.347	2.347	10.946	6.417	
5(2, 4) - 4(1, 3)A		232694.185(2.477)	1.000	1.603	1.603	15.941	8.179	
4(4, 0) - 5(3, 3)A		232954.097(15.467)	1.000	0.077	0.077	31.581	23.810	
4(2, 2) - 5(1, 5)A		53756.373(1.646)	1.000	0.413	0.413	12.739	10.946	
4(3, 1) - 5(2, 4)A		139546.842(5.137)	1.000	0.229	0.229	20.596	15.941	
5(1, 4) - 5(1, 5)A	15968.452(0.020)	15967.402(0.982)	1.000	2.387	2.387	11.478	10.946	75A
5(2, 4) - 5(0, 5)A		189561.973(2.511)	1.000	0.032	0.032	15.941	9.618	
5(3, 2) - 5(2, 3)A		235289.635(4.920)	1.000	1.704	1.704	23.811	15.962	
5(1, 4) - 5(0, 5)A		55768.838(0.998)	1.000	3.832	3.832	11.478	9.618	
5(2, 3) - 5(1, 4)A		134421.163(1.843)	1.000	2.205	2.205	15.962	11.478	
5(2, 4) - 5(1, 5)A		149760.537(1.876)	1.000	1.878	1.878	15.941	10.946	
5(3, 3) - 5(2, 4)A		235912.324(4.847)	1.000	1.701	1.701	23.810	15.941	
6(4, 2) - 5(4, 1)A		115621.859(2.646)	1.000	21.676	21.676	38.651	34.795	
6(2, 4) - 5(2, 3)A	116117.620(0.180)	116117.521(0.887)	1.000	34.677	34.677	19.835	15.962	
6(0, 6) - 5(0, 5)A	114959.650(0.100)	114960.646(1.037)	1.000	38.972	38.972	13.453	9.618	75B
6(5, 1) - 5(5, 0)A	115605.720(0.200)	115605.658(4.293)	1.000	11.922	11.922	52.746	48.890	
6(3, 3) - 5(3, 2)A	115671.300(0.200)	115670.449(1.453)	1.000	29.262	29.262	27.669	23.811	
6(1, 5) - 5(1, 4)A	118625.890(0.150)	118626.264(0.966)	1.000	37.923	37.923	15.435	11.478	75B
6(5, 2) - 5(5, 1)A	115605.720(0.200)	115605.658(4.293)	1.000	11.922	11.922	52.746	48.890	
6(3, 4) - 5(3, 3)A	115660.440(0.200)	115659.780(1.453)	1.000	29.262	29.262	27.668	23.810	
6(1, 6) - 5(1, 5)A	112248.720(0.160)	112249.203(0.946)	1.000	37.924	37.924	14.690	10.946	75B
6(4, 3) - 5(4, 2)A		115621.798(2.646)	1.000	21.676	21.676	38.651	34.795	
6(2, 5) - 5(2, 4)A	115493.900(0.200)	115493.342(0.896)	1.000	34.677	34.677	19.794	15.941	
5(3, 3) - 6(2, 4)A		119166.774(4.848)	1.000	0.381	0.381	23.810	19.835	
6(0, 6) - 5(1, 5)A		75159.211(1.050)	1.000	2.189	2.189	13.453	10.946	
5(4, 2) - 6(3, 3)A		213620.708(15.084)	1.000	0.191	0.191	34.795	27.669	
5(2, 4) - 6(1, 5)A	15164.478(0.020)	15166.872(1.554)	1.000	0.698	0.698	15.941	15.435	75A
6(1, 6) - 5(0, 5)A		152050.638(1.567)	1.000	2.797	2.797	14.690	9.618	
6(2, 5) - 5(1, 4)A		249286.478(2.443)	1.000	1.797	1.797	19.794	11.478	
5(4, 1) - 6(3, 4)A		213636.732(15.077)	1.000	0.191	0.191	34.795	27.668	
5(2, 3) - 6(1, 6)A	38138.436(0.020)	38139.363(1.551)	1.000	0.545	0.545	15.962	14.690	75A
5(3, 2) - 6(2, 5)A		120424.321(4.716)	1.000	0.380	0.380	23.811	19.794	
6(1, 5) - 6(1, 6)A	22345.900(0.020)	22344.463(1.202)	1.000	2.018	2.018	15.435	14.690	75A
6(2, 4) - 6(2, 5)A		1252.207(0.278)	1.000	8.001	8.001	19.835	19.794	
6(2, 5) - 6(0, 6)A		190094.669(2.420)	1.000	0.053	0.053	19.794	13.453	
6(3, 3) - 6(2, 4)A		234842.563(4.748)	1.000	2.170	2.170	27.669	19.835	
6(1, 5) - 6(0, 6)A		59434.455(1.039)	1.000	4.363	4.363	15.435	13.453	
6(2, 4) - 6(1, 5)A		131912.421(1.793)	1.000	2.774	2.774	19.835	15.435	
6(2, 5) - 6(1, 6)A		153004.677(1.816)	1.000	2.228	2.228	19.794	14.690	
6(3, 4) - 6(2, 5)A		236078.762(4.612)	1.000	2.163	2.163	27.668	19.794	
7(6, 1) - 6(6, 0)A		134874.660(7.836)	1.000	12.076	12.076	74.447	69.948	
7(4, 3) - 6(4, 2)A		134907.318(3.508)	1.000	30.655	30.655	43.151	38.651	
7(2, 5) - 6(2, 4)A		135684.701(1.230)	1.000	41.797	41.797	24.361	19.835	
7(0, 7) - 6(0, 6)A		133854.938(1.063)	1.000	45.451	45.451	17.918	13.453	
7(5, 2) - 6(5, 1)A		134881.491(5.440)	1.000	22.295	22.295	57.245	52.746	
7(3, 4) - 6(3, 3)A		134985.735(2.073)	1.000	37.157	37.157	32.172	27.669	
7(1, 6) - 6(1, 5)A		138319.722(1.125)	1.000	44.575	44.575	20.049	15.435	
7(5, 3) - 6(5, 2)A		134881.491(5.440)	1.000	22.295	22.295	57.245	52.746	
7(3, 5) - 6(3, 4)A		134961.760(2.076)	1.000	37.157	37.157	32.170	27.668	
7(1, 7) - 6(1, 6)A		130892.332(1.000)	1.000	44.578	44.578	19.056	14.690	
7(6, 2) - 6(6, 1)A		134874.660(7.836)	1.000	12.076	12.076	74.447	69.948	
7(4, 4) - 6(4, 3)A		134907.116(3.508)	1.000	30.655	30.655	43.151	38.651	
7(2, 6) - 6(2, 5)A		134693.706(1.264)	1.000	41.796	41.796	24.287	19.794	
6(3, 4) - 7(2, 5)A		99141.854(4.413)	1.000	0.543	0.543	27.668	24.361	
7(0, 7) - 6(1, 6)A	96765.325(0.125)	96764.946(1.177)	1.000	2.724	2.724	17.918	14.690	
6(4, 3) - 7(3, 4)A		194256.771(14.593)	1.000	0.327	0.327	38.651	32.172	
7(1, 6) - 6(2, 5)A	7661.224(0.020)	7659.508(1.533)	1.000	0.921	0.921	20.049	19.794	75A
7(1, 7) - 6(0, 6)A		167982.323(1.628)	1.000	3.279	3.279	19.056	13.453	

Table 4. The microwave spectrum for the A symmetry state of $^{12}CH_3{}^{12}CH^{16}O$—Continued

J' K'₋ K'₊ – J" K"₋ K"₊ S	Measured Transition Freq. Unc. (MHz)	Calculated Transition Freq. Unc. (MHz)	Line Strength Relative μ_x^2	Line Strength Rig.Rotor $x S_{J';J"}$	Total	Energy Levels Upper (cm^{-1})	Energy Levels Lower (cm^{-1})	Ref.
6(4, 2) – 7(3, 5)A		194296.831(14.576)	1.000	0.327	0.327	38.651	32.170	
6(2, 4) – 7(1, 7)A	23364.771(0.020)	23364.552(1.514)	1.000	0.658	0.658	19.835	19.056	75A
6(3, 3) – 7(2, 6)A		101401.064(4.201)	1.000	0.540	0.540	27.669	24.287	
7(1, 6) – 7(1, 7)A	29773.695(0.020)	29771.853(1.410)	1.000	1.751	1.751	20.049	19.056	75A
7(2, 5) – 7(2, 6)A		2243.201(0.448)	1.000	6.892	6.892	24.361	24.287	
7(2, 6) – 7(0, 7)A		190933.437(2.615)	1.000	0.082	0.082	24.287	17.918	
7(3, 4) – 7(2, 5)A		234143.598(4.786)	1.000	2.628	2.628	32.172	24.361	
7(1, 6) – 7(0, 7)A		63899.238(1.114)	1.000	4.816	4.816	20.049	17.918	
7(2, 5) – 7(1, 6)A		129277.400(1.944)	1.000	3.391	3.391	24.361	20.049	
7(2, 6) – 7(1, 7)A		156806.052(2.004)	1.000	2.553	2.553	24.287	19.056	
7(3, 5) – 7(2, 6)A		236346.815(4.578)	1.000	2.612	2.612	32.170	24.287	
8(6, 2) – 7(6, 1)A		154148.559(9.547)	1.000	22.759	22.759	79.589	74.447	
8(4, 4) – 7(4, 3)A		154199.853(4.609)	1.000	39.016	39.016	48.295	43.151	
8(2, 6) – 7(2, 5)A		155341.141(1.917)	1.000	48.762	48.762	29.543	24.361	
8(0, 8) – 7(0, 7)A		152636.103(1.362)	1.000	51.923	51.923	23.009	17.918	
8(7, 1) – 7(7, 0)A		154148.727(12.803)	1.000	12.193	12.193	99.904	94.762	
8(5, 3) – 7(5, 2)A		154161.121(6.813)	1.000	31.701	31.701	62.387	57.245	
8(3, 5) – 7(3, 4)A		154320.769(2.957)	1.000	44.705	44.705	37.319	32.172	
8(1, 7) – 7(1, 6)A		157974.654(1.683)	1.000	51.186	51.186	25.319	20.049	
8(7, 2) – 7(7, 1)A		154148.727(12.803)	1.000	12.193	12.193	99.904	94.762	
8(5, 4) – 7(5, 3)A		154161.118(6.813)	1.000	31.701	31.701	62.387	57.245	
8(3, 6) – 7(3, 5)A		154272.911(2.964)	1.000	44.705	44.705	37.316	32.170	
8(1, 8) – 7(1, 7)A		149507.969(1.325)	1.000	51.191	51.191	24.043	19.056	
8(6, 3) – 7(6, 2)A		154148.559(9.547)	1.000	22.759	22.759	79.589	74.447	
8(4, 5) – 7(4, 4)A		154199.297(4.609)	1.000	39.016	39.016	48.295	43.151	
8(2, 7) – 7(2, 6)A		153871.755(1.959)	1.000	48.759	48.759	29.419	24.287	
7(3, 5) – 8(2, 6)A		78762.473(3.878)	1.000	0.710	0.710	32.170	29.543	
8(0, 8) – 7(1, 7)A	118508.500(0.200)	118508.718(1.507)	1.000	3.301	3.301	23.009	19.056	
7(4, 4) – 8(3, 5)A		174843.117(13.988)	1.000	0.476	0.476	43.151	37.319	
8(1, 7) – 7(2, 6)A	30941.333(0.020)	30940.456(1.726)	1.000	1.161	1.161	25.319	24.287	75A
8(1, 8) – 7(0, 7)A		183635.354(1.947)	1.000	3.797	3.797	24.043	17.918	
7(4, 3) – 8(3, 6)A		174931.237(13.952)	1.000	0.476	0.476	43.151	37.316	
7(2, 5) – 8(1, 8)A	9542.776(0.020)	9541.284(1.510)	1.000	0.747	0.747	24.043	24.361	75A
7(3, 4) – 8(2, 7)A		82515.045(3.584)	1.000	0.703	0.703	32.172	29.419	
8(1, 7) – 8(1, 8)A	38240.715(0.020)	38238.539(1.716)	1.000	1.550	1.550	25.319	24.043	75A
8(2, 6) – 8(2, 7)A		3712.588(0.655)	1.000	6.035	6.035	29.543	29.419	
8(2, 7) – 8(0, 8)A		192169.088(3.165)	1.000	0.117	0.117	29.419	23.009	
8(3, 5) – 8(2, 6)A		233123.226(5.124)	1.000	3.084	3.084	37.319	29.543	
8(1, 7) – 8(0, 8)A		69237.789(1.299)	1.000	5.183	5.183	25.319	23.009	
8(2, 6) – 8(1, 7)A		126643.887(2.330)	1.000	4.060	4.060	29.543	25.319	
8(2, 7) – 8(1, 8)A		161169.838(2.540)	1.000	2.855	2.855	29.419	24.043	
8(3, 6) – 8(2, 7)A		236747.972(4.865)	1.000	3.053	3.053	37.316	29.419	
9(8, 1) – 8(8, 0)A		173423.543(19.406)	1.000	12.283	12.283	129.126	123.341	
9(6, 3) – 8(6, 2)A		173424.893(11.519)	1.000	32.513	32.513	85.374	79.589	
9(4, 5) – 8(4, 4)A		173500.575(5.993)	1.000	46.963	46.963	54.082	48.295	
9(2, 7) – 8(2, 6)A		175089.558(2.976)	1.000	55.625	55.625	35.383	29.543	
9(0, 9) – 8(0, 8)A		171297.924(2.064)	1.000	58.390	58.390	28.723	23.009	
9(7, 2) – 8(7, 1)A		173421.501(15.171)	1.000	23.121	23.121	105.689	99.904	
9(5, 4) – 8(5, 3)A		173445.092(8.457)	1.000	40.461	40.461	68.173	62.387	
9(3, 6) – 8(3, 5)A		173680.322(4.145)	1.000	52.019	52.019	43.113	37.319	
9(1, 8) – 8(1, 7)A		177583.616(2.683)	1.000	57.769	57.769	31.242	25.319	
9(7, 3) – 8(7, 2)A		173421.501(15.171)	1.000	23.121	23.121	105.689	99.904	
9(5, 5) – 8(5, 4)A		173445.082(8.457)	1.000	40.461	40.461	68.173	62.387	
9(3, 7) – 8(3, 6)A		173592.824(4.159)	1.000	52.019	52.019	43.107	37.316	
9(1, 9) – 8(1, 8)A		168093.915(2.033)	1.000	57.777	57.777	29.650	24.043	
9(8, 2) – 8(8, 1)A		173423.543(19.406)	1.000	12.283	12.283	129.126	123.341	
9(6, 4) – 8(6, 3)A		173424.893(11.519)	1.000	32.513	32.513	85.374	79.589	
9(4, 6) – 8(4, 5)A		173499.243(5.993)	1.000	46.963	46.963	54.082	48.295	
9(2, 8) – 8(2, 7)A		173024.386(2.997)	1.000	55.618	55.618	35.191	29.419	
8(5, 4) – 9(4, 5)A		248985.328(32.187)	1.000	0.424	0.424	62.387	54.082	
8(3, 6) – 9(2, 7)A		57945.826(3.220)	1.000	0.881	0.881	37.316	35.383	
9(0, 9) – 8(1, 8)A		140298.674(2.184)	1.000	3.919	3.919	28.723	24.043	
8(4, 5) – 9(3, 6)A		155362.093(13.257)	1.000	0.634	0.634	48.295	43.113	
9(1, 8) – 8(2, 7)A		54652.318(2.316)	1.000	1.420	1.420	31.242	29.419	
9(1, 9) – 8(0, 8)A		199093.166(2.635)	1.000	4.354	4.354	29.650	23.009	

Table 4. The microwave spectrum for the A symmetry state of $^{12}CH_3{}^{12}CH^{16}O$–Continued

J' K'₋ K'₊ – J" K"₋ K"₊ S	Measured Transition Freq. Unc. (MHz)	Calculated Transition Freq. Unc. (MHz)	Line Strength Relative	Rig.Rotor μ_x^2 x$S_{J';J"}$	Total	Energy Levels Upper (cm^{-1})	Lower (cm^{-1})	Ref
8(4, 4) - 9(3, 7)A		155538.266(13.191)	1.000	0.634	0.634	48.295	43.107	
9(1, 9) - 8(2, 6)A		3211.490(1.510)	1.000	0.809	0.809	29.650	29.543	
8(5, 3) - 9(4, 6)A		248987.498(32.184)	1.000	0.424	0.424	62.387	54.082	
8(3, 5) - 9(2, 8)A		63811.428(2.873)	1.000	0.866	0.866	37.319	35.191	
9(1, 8) - 9(1, 9)A		47728.240(2.350)	1.000	1.393	1.393	31.242	29.650	
9(2, 7) - 9(2, 8)A		5777.759(0.889)	1.000	5.347	5.347	35.383	35.191	
9(2, 8) - 9(0, 9)A		193895.550(4.053)	1.000	0.160	0.160	35.191	28.723	
9(3, 6) - 9(2, 7)A		231713.990(5.792)	1.000	3.545	3.545	43.113	35.383	
9(1, 8) - 9(0, 9)A		75523.482(1.766)	1.000	5.461	5.461	31.242	28.723	
9(2, 7) - 9(1, 8)A		124149.828(2.924)	1.000	4.781	4.781	35.383	31.242	
9(2, 8) - 9(1, 9)A		166100.309(3.455)	1.000	3.133	3.133	35.191	29.650	
9(3, 7) - 9(2, 8)A		237316.410(5.543)	1.000	3.489	3.489	43.107	35.191	
10(8, 2) - 9(8, 1)A		192695.203(22.525)	1.000	23.410	23.410	135.553	129.126	
10(6, 4) - 9(6, 3)A		192703.964(13.793)	1.000	41.617	41.617	91.802	85.374	
10(4, 6) - 9(4, 5)A		192810.676(7.703)	1.000	54.622	54.622	60.514	54.082	
10(2, 8) - 9(2, 7)A		194926.848(4.430)	1.000	62.417	62.417	41.885	35.383	
10(0,10) - 9(0, 9)A		189839.925(3.152)	1.000	64.853	64.853	35.055	28.723	
10(9, 1) - 9(9, 0)A		192692.752(27.863)	1.000	12.355	12.355	162.121	155.694	
10(7, 3) - 9(7, 2)A		192695.750(17.833)	1.000	33.164	33.164	112.116	105.689	
10(5, 5) - 9(5, 4)A		192733.951(10.413)	1.000	48.770	48.770	74.602	68.173	
10(3, 7) - 9(3, 6)A		193069.912(5.674)	1.000	59.171	59.171	49.553	43.113	
10(1, 9) - 9(1, 8)A		197138.412(4.096)	1.000	64.330	64.330	37.818	31.242	
10(9, 2) - 9(9, 1)A		192692.752(27.863)	1.000	12.355	12.355	162.121	155.694	
10(7, 4) - 9(7, 3)A		192695.750(17.833)	1.000	33.164	33.164	112.116	105.689	
10(5, 6) - 9(5, 5)A		192733.924(10.413)	1.000	48.770	48.770	74.602	68.173	
10(3, 8) - 9(3, 7)A		192920.489(5.697)	1.000	59.171	59.171	49.542	43.107	
10(1,10) - 9(1, 9)A		186648.575(3.110)	1.000	64.344	64.344	35.876	29.650	
10(8, 3) - 9(8, 2)A		192695.203(22.525)	1.000	23.410	23.410	135.553	129.126	
10(6, 5) - 9(6, 4)A		192703.964(13.793)	1.000	41.617	41.617	91.802	85.374	
10(4, 7) - 9(4, 6)A		192807.794(7.704)	1.000	54.622	54.622	60.514	54.082	
10(2, 9) - 9(2, 8)A		192148.564(4.388)	1.000	62.404	62.404	41.600	35.191	
9(5, 5) - 10(4, 6)A		229619.733(31.255)	1.000	0.572	0.572	68.173	60.514	
9(3, 7) - 10(2, 8)A	36613.186(0.020)	36611.802(2.470)	1.000	1.054	1.054	43.107	41.885	75A
10(0,10) - 9(1, 9)A		162044.684(3.251)	1.000	4.578	4.578	35.055	29.650	
9(4, 6) - 10(3, 7)A		135791.424(12.388)	1.000	0.796	0.796	54.082	49.553	
10(1, 9) - 9(2, 8)A		78766.343(3.407)	1.000	1.701	1.701	37.818	35.191	
10(1,10) - 9(0, 9)A		214443.816(3.707)	1.000	4.950	4.950	35.876	28.723	
9(4, 5) - 10(3, 8)A		136118.351(12.277)	1.000	0.796	0.796	54.082	49.542	
10(1,10) - 9(2, 7)A	14766.065(0.020)	14770.506(1.541)	1.000	0.844	0.844	35.876	35.383	75A
9(5, 4) - 10(4, 7)A		229624.795(31.250)	1.000	0.572	0.572	68.173	60.514	
9(3, 6) - 10(2, 9)A		45343.185(2.143)	1.000	1.026	1.026	43.113	41.600	
10(1, 9) - 10(1,10)A		58218.077(3.550)	1.000	1.269	1.269	37.818	35.876	
10(2, 8) - 10(2, 9)A	8556.062(0.010)	8556.043(1.155)	1.000	4.779	4.779	41.885	41.600	75A
10(2, 9) - 10(0,10)A		196204.189(5.261)	1.000	0.210	0.210	41.600	35.055	
10(3, 7) - 10(2, 8)A		229857.053(6.768)	1.000	4.017	4.017	49.553	41.885	
10(1, 9) - 10(0,10)A		82821.968(2.714)	1.000	5.652	5.652	37.818	35.055	
10(2, 8) - 10(1, 9)A		121938.265(3.672)	1.000	5.547	5.547	41.885	37.818	
10(2, 9) - 10(1,10)A		171600.299(4.772)	1.000	3.387	3.387	41.600	35.876	
10(3, 8) - 10(2, 9)A		238088.335(6.606)	1.000	3.922	3.922	49.542	41.600	
11(10, 1) - 10(10, 0)A		211951.077(38.391)	1.000	12.414	12.414	198.891	191.821	
11(8, 3) - 10(8, 2)A		211967.607(25.970)	1.000	33.696	33.696	142.624	135.553	
11(6, 5) - 10(6, 4)A		211986.079(16.410)	1.000	50.248	50.248	98.873	91.802	
11(4, 7) - 10(4, 6)A		212131.463(9.778)	1.000	62.070	62.070	67.590	60.514	
11(2, 9) - 10(2, 8)A		214843.554(6.311)	1.000	69.159	69.159	49.052	41.885	
11(0,11) - 10(0,10)A		208267.875(4.601)	1.000	71.314	71.314	42.002	35.055	
11(9, 2) - 10(9, 1)A		211962.649(31.826)	1.000	23.646	23.646	169.191	162.121	
11(7, 4) - 10(7, 3)A		211971.634(20.828)	1.000	42.563	42.563	119.187	112.116	
11(5, 6) - 10(5, 5)A		212028.253(12.723)	1.000	56.750	56.750	81.674	74.602	
11(3, 8) - 10(3, 7)A		212495.845(7.581)	1.000	66.205	66.205	56.641	49.553	
11(1,10) - 10(1, 9)A		216630.056(5.923)	1.000	70.875	70.875	45.044	37.818	
11(9, 3) - 10(9, 2)A		211962.649(31.826)	1.000	23.646	23.646	169.191	162.121	
11(7, 5) - 10(7, 4)A		211971.634(20.828)	1.000	42.563	42.563	119.187	112.116	
11(5, 7) - 10(5, 6)A		212028.185(12.723)	1.000	56.750	56.750	81.674	74.602	
11(3, 9) - 10(3, 8)A		212254.286(7.614)	1.000	66.205	66.205	56.622	49.542	
11(1,11) - 10(1,10)A		205170.967(4.546)	1.000	70.897	70.897	42.720	35.876	

Table 4. The microwave spectrum for the A symmetry state of $^{12}CH_3{}^{12}CH^{16}O$—Continued

J' K'_- K'_+ - J" K''_- K''_+ S	Measured Transition Freq. Unc. (MHz)	Calculated Transition Freq. Unc. (MHz)	Line Strength Relative	Rig.Rotor μ_x^2 x $S_{J';J''}$	Total	Energy Levels Upper (cm^{-1})	Lower (cm^{-1})	Ref.
11(10, 2) - 10(10, 1)A		211951.077(38.391)	1.000	12.414	12.414	198.891	191.821	
11(8, 4) - 10(8, 3)A		211967.607(25.970)	1.000	33.696	33.696	142.624	135.553	
11(6, 6) - 10(6, 5)A		211986.078(16.410)	1.000	50.248	50.248	98.873	91.802	
11(4, 8) - 10(4, 7)A		212125.708(9.780)	1.000	62.070	62.070	67.589	60.514	
11(2,10) - 10(2, 9)A		211241.338(6.150)	1.000	69.135	69.135	48.646	41.600	
10(5, 6) - 11(4, 7)A		210222.194(30.158)	1.000	0.727	0.727	74.602	67.590	
10(3, 8) - 11(2, 9)A	14691.111(0.020)	14688.737(1.949)	1.000	1.228	1.228	49.542	49.052	75A
11(0,11) - 10(1,10)A		183663.985(4.704)	1.000	5.274	5.274	42.002	35.876	
10(4, 7) - 11(3, 8)A		116103.372(11.367)	1.000	0.962	0.962	60.514	56.641	
11(1,10) - 10(2, 9)A		103247.835(5.031)	1.000	2.006	2.006	45.044	41.600	
11(1,11) - 10(0,10)A		229774.858(5.147)	1.000	5.585	5.585	42.720	35.055	
10(4, 6) - 11(3, 9)A		116674.742(11.197)	1.000	0.961	0.961	60.514	56.622	
11(1,11) - 10(2, 8)A	25008.607(0.020)	25014.625(1.831)	1.000	0.852	0.852	42.720	41.885	75A
10(5, 5) - 11(4, 8)A		210233.038(30.148)	1.000	0.727	0.727	74.602	67.589	
10(3, 7) - 11(2,10)A	27173.880(0.020)	27171.758(1.704)	1.000	1.180	1.180	49.553	48.646	75A
11(1,10) - 11(1,11)A		69677.167(5.473)	1.000	1.170	1.170	45.044	42.720	
11(2, 9) - 11(2,10)A	12158.059(0.020)	12158.260(1.512)	1.000	4.299	4.299	49.052	48.646	75A
11(2,10) - 11(0,11)A		199177.652(6.812)	1.000	0.264	0.264	48.646	42.002	
11(3, 8) - 11(2, 9)A		227509.344(8.010)	1.000	4.505	4.505	56.641	49.052	
11(1,10) - 11(0,11)A		91184.149(4.299)	1.000	5.763	5.763	45.044	42.002	
11(2, 9) - 11(1,10)A		120151.763(4.524)	1.000	6.344	6.344	49.052	45.044	
11(2,10) - 11(1,11)A		177670.670(6.542)	1.000	3.617	3.617	48.646	42.720	
11(3, 9) - 11(2,10)A		239101.282(8.012)	1.000	4.351	4.351	56.622	48.646	
12(10, 2) - 11(10, 1)A		231218.242(43.291)	1.000	23.843	23.843	206.604	198.891	
12(8, 4) - 11(8, 3)A		231240.829(29.780)	1.000	43.351	43.351	150.337	142.624	
12(6, 6) - 11(6, 5)A		231271.541(19.411)	1.000	58.524	58.524	106.587	98.873	
12(4, 8) - 11(4, 7)A		231464.394(12.258)	1.000	69.361	69.361	75.310	67.590	
12(2,10) - 11(2, 9)A		234824.215(8.658)	1.000	75.865	75.865	56.885	49.052	
12(0,12) - 11(0,11)A		226593.394(6.416)	1.000	77.776	77.776	49.561	42.002	
12(11, 1) - 11(11, 0)A		231197.368(51.210)	1.000	12.464	12.464	239.427	231.715	
12(9, 3) - 11(9, 2)A		231232.715(36.147)	1.000	34.139	34.139	176.905	169.191	
12(7, 5) - 11(7, 4)A		231249.315(24.198)	1.000	51.480	51.480	126.901	119.187	
12(5, 7) - 11(5, 6)A		231328.559(15.428)	1.000	64.484	64.484	89.391	81.674	
12(3, 9) - 11(3, 8)A		231965.195(9.906)	1.000	73.150	73.150	64.378	56.641	
12(1,11) - 11(1,10)A		236048.795(8.180)	1.000	77.405	77.405	52.918	45.044	
12(11, 2) - 11(11, 1)A		231197.368(51.210)	1.000	12.464	12.464	239.427	231.715	
12(9, 4) - 11(9, 3)A		231232.715(36.147)	1.000	34.139	34.139	176.905	169.191	
12(7, 6) - 11(7, 5)A		231249.315(24.198)	1.000	51.480	51.480	126.901	119.187	
12(5, 8) - 11(5, 7)A		231328.405(15.428)	1.000	64.484	64.484	89.391	81.674	
12(3,10) - 11(3, 9)A		231591.989(9.946)	1.000	73.149	73.149	64.347	56.622	
12(1,12) - 11(1,11)A		223660.720(6.349)	1.000	77.439	77.439	50.180	42.720	
12(10, 3) - 11(10, 2)A		231218.242(43.291)	1.000	23.843	23.843	206.604	198.891	
12(8, 5) - 11(8, 4)A		231240.829(29.780)	1.000	43.351	43.351	150.337	142.624	
12(6, 7) - 11(6, 6)A		231271.539(19.411)	1.000	58.524	58.524	106.587	98.873	
12(4, 9) - 11(4, 8)A		231453.629(12.262)	1.000	69.361	69.361	75.310	67.589	
12(2,11) - 11(2,10)A		230299.874(8.311)	1.000	75.826	75.826	56.328	48.646	
11(5, 7) - 12(4, 8)A		190785.985(28.886)	1.000	0.887	0.887	81.674	75.310	
12(2,10) - 11(3, 9)A	7877.613(0.020)	7881.193(2.595)	1.000	1.405	1.405	56.885	56.622	75A
12(0,12) - 11(1,11)A		205086.411(6.540)	1.000	6.001	6.001	49.561	42.720	
11(4, 8) - 12(3, 9)A		96263.885(10.189)	1.000	1.130	1.130	67.589	64.378	
12(1,11) - 11(2,10)A		128055.291(7.215)	1.000	2.338	2.338	52.918	48.646	
12(1,12) - 11(0,11)A		245167.702(6.955)	1.000	6.256	6.256	50.180	42.002	
11(4, 7) - 12(3,10)A		97214.216(9.949)	1.000	1.128	1.128	67.590	64.347	
12(1,12) - 11(2, 9)A	33824.155(0.020)	33831.791(2.799)	1.000	0.836	0.836	50.180	49.052	75A
11(5, 6) - 12(4, 9)A		190807.662(28.866)	1.000	0.887	0.887	81.674	75.310	
11(3, 8) - 12(2,11)A	9370.618(0.020)	9367.730(2.151)	1.000	1.325	1.325	56.641	56.328	75A
12(3, 9) - 12(3,10)A		939.527(0.537)	1.000	9.262	9.262	64.378	64.347	
12(1,11) - 12(1,12)A		82065.241(8.233)	1.000	1.090	1.090	52.918	50.180	
12(2,10) - 12(2,11)A	16682.008(0.020)	16682.601(2.110)	1.000	3.888	3.888	56.885	56.328	75A
12(2,11) - 12(0,12)A		202884.132(8.787)	1.000	0.321	0.321	56.328	49.561	
12(3, 9) - 12(2,10)A		224650.323(9.484)	1.000	5.016	5.016	64.378	56.885	
12(1,11) - 12(0,12)A		100639.550(6.669)	1.000	5.803	5.803	52.918	49.561	
12(2,10) - 12(1,11)A		118927.184(5.434)	1.000	7.154	7.154	56.885	52.918	
12(2,11) - 12(1,12)A		184309.823(8.845)	1.000	3.823	3.823	56.328	50.180	
12(3,10) - 12(2,11)A		240393.398(9.721)	1.000	4.775	4.775	64.347	56.328	

Table 5. The microwave spectrum for the E-symmetry state of $^{12}CH_3{}^{12}CH^{16}O$

J' K'₋ K'₊ - J" K"₋ K"₊ S	Measured Transition Freq. Unc. (MHz)	Calculated Transition Freq. Unc. (MHz)	Line Strength Relative μ_x^2	Rig.Rotor $^xS_{J';J''}$	Total	Energy Levels Upper (cm^{-1})	Lower	Ref.
1(0, 1) - 0(0, 0)E	19262.160(0.020)	19262.090(0.327)	1.000	6.502	6.502	0.712	0.069	75A
1(1, 1) - 0(0, 0)E		65156.176(1.506)	0.786	0.757	0.595	2.243	0.069	
1(1, 0) - 0(0, 0)E		67009.575(1.256)	0.214	0.757	0.162	2.304	0.069	
1(1, 0) - 1(1, 1)E		1853.399(1.433)	0.328	9.754	3.201	2.304	2.243	
1(1, 0) - 1(0, 1)E		47747.485(1.021)	0.786	1.135	0.893	2.304	0.712	
1(1, 1) - 1(0, 1)E		45894.086(1.303)	0.214	1.135	0.242	2.243	0.712	
2(0, 2) - 1(0, 1)E	38505.999(0.020)	38505.919(0.622)	1.000	13.004	13.004	1.996	0.712	75A
2(1, 1) - 1(1, 0)E	39362.504(0.020)	39361.326(0.733)	0.935	9.754	9.117	3.617	2.304	75A
2(1, 2) - 1(1, 0)E	35837.327(0.020)	35834.220(1.205)	0.065	9.754	0.637	3.500	2.304	75A
2(1, 2) - 1(1, 1)E	37686.868(0.020)	37687.620(0.664)	0.935	9.754	9.117	3.500	2.243	75A
2(1, 1) - 1(1, 1)E		41214.726(1.195)	0.065	9.754	0.637	3.617	2.243	
2(2, 0) - 1(0, 1)E		227052.890(3.724)	0.504	0.001	0.001	8.285	0.712	
2(2, 1) - 1(0, 1)E		224706.566(4.000)	0.496	0.001	0.001	8.207	0.712	
2(2, 0) - 1(1, 1)E		181158.804(3.228)	0.092	1.122	0.104	8.285	2.243	
2(2, 1) - 1(1, 1)E		178812.480(2.860)	0.908	1.122	1.019	8.207	2.243	
1(1, 1) - 2(0, 2)E	7391.293(0.050)	7388.166(1.096)	0.786	0.391	0.308	2.243	1.996	75A
1(1, 0) - 2(0, 2)E	9241.543(0.020)	9241.566(0.783)	0.214	0.391	0.084	2.304	1.996	75A
2(1, 2) - 1(0, 1)E	83584.260(0.180)	83581.705(1.482)	0.952	1.135	1.080	3.500	0.712	75C
2(1, 1) - 1(0, 1)E		87108.811(1.408)	0.048	1.135	0.055	3.617	0.712	
2(2, 1) - 1(1, 0)E		176959.081(3.648)	0.092	1.135	0.105	8.207	2.304	
2(2, 0) - 1(1, 0)E		179305.405(2.850)	0.908	1.135	1.030	8.285	2.304	
2(1, 1) - 2(1, 2)E		3527.106(0.698)	0.816	5.419	4.420	3.617	3.500	
2(2, 1) - 2(0, 2)E		186200.646(3.565)	0.504	0.002	0.001	8.207	1.996	
2(2, 0) - 2(0, 2)E		188546.971(3.284)	0.496	0.002	0.001	8.285	1.996	
2(1, 1) - 2(0, 2)E		48602.892(0.889)	0.952	1.871	1.780	3.617	1.996	
2(1, 2) - 2(0, 2)E		45075.786(1.020)	0.048	1.871	0.091	3.500	1.996	
2(2, 0) - 2(1, 1)E		139944.079(2.515)	0.718	0.652	0.468	8.285	3.617	
2(2, 1) - 2(1, 1)E		137597.754(3.038)	0.282	0.652	0.184	8.207	3.617	
2(2, 1) - 2(1, 2)E		141124.860(2.648)	0.718	0.631	0.453	8.207	3.500	
2(2, 0) - 2(1, 2)E		143471.185(2.713)	0.282	0.631	0.178	8.285	3.500	
3(2, 1) - 2(2, 0)E		57819.355(0.623)	1.000	10.838	10.835	10.214	8.285	
3(0, 3) - 2(0, 2)E		57713.267(0.855)	1.000	19.503	19.503	3.921	1.996	
3(1, 2) - 2(1, 1)E		59284.585(0.858)	0.989	17.339	17.146	5.595	3.617	
3(1, 3) - 2(1, 1)E		52738.132(0.913)	0.011	17.339	0.193	5.377	3.617	
3(1, 3) - 2(1, 2)E		56265.238(0.790)	0.989	17.339	17.146	5.377	3.500	
3(1, 2) - 2(1, 2)E		62811.691(1.015)	0.011	17.339	0.193	5.595	3.500	
3(2, 2) - 2(2, 1)E		57829.046(0.616)	1.000	10.837	10.835	10.136	8.207	
3(2, 1) - 2(0, 2)E		246366.325(3.634)	0.519	0.004	0.002	10.214	1.996	
3(2, 2) - 2(0, 2)E		244029.692(3.908)	0.481	0.004	0.002	10.136	1.996	
3(2, 1) - 2(1, 2)E		201290.539(3.005)	0.303	1.218	0.369	10.214	3.500	
3(2, 2) - 2(1, 2)E		198953.906(2.984)	0.697	1.218	0.849	10.136	3.500	
3(0, 3) - 2(1, 2)E	12635.228(0.020)	12637.481(0.840)	0.952	0.800	0.761	3.921	3.500	75A
3(0, 3) - 2(1, 1)E	9109.970(0.100)	9110.375(0.643)	0.048	0.800	0.039	3.921	3.617	75A
2(2, 1) - 3(1, 2)E		78313.169(2.526)	0.389	0.132	0.051	8.207	5.595	
2(2, 1) - 3(1, 3)E		84859.623(2.388)	0.611	0.132	0.080	8.207	5.377	
3(1, 3) - 2(0, 2)E		101341.024(1.547)	0.987	1.522	1.502	5.377	1.996	
3(1, 2) - 2(0, 2)E		107887.477(1.598)	0.013	1.522	0.020	5.595	1.996	
3(2, 2) - 2(1, 1)E		195426.800(3.320)	0.303	1.261	0.382	10.136	3.617	
3(2, 1) - 2(1, 1)E		197763.433(2.834)	0.697	1.261	0.879	10.214	3.617	
2(2, 0) - 3(1, 3)E		87205.947(2.256)	0.389	0.123	0.048	8.285	5.377	
2(2, 0) - 3(1, 2)E		80659.493(2.230)	0.611	0.123	0.075	8.285	5.595	
3(1, 2) - 3(1, 3)E		6546.454(0.519)	0.947	3.794	3.592	5.595	5.377	
3(2, 2) - 3(0, 3)E		186316.425(3.317)	0.519	0.007	0.004	10.136	3.921	
3(2, 1) - 3(0, 3)E		188653.058(3.033)	0.481	0.007	0.003	10.214	3.921	
3(3, 0) - 3(2, 1)E		234237.361(5.538)	1.000	0.672	0.672	18.027	10.214	
3(1, 2) - 3(0, 3)E		50174.210(0.882)	0.987	2.574	2.539	5.595	3.921	
3(1, 3) - 3(0, 3)E		43627.756(0.884)	0.013	2.574	0.035	5.377	3.921	
3(2, 1) - 3(1, 2)E		138478.848(2.385)	0.634	1.170	0.741	10.214	5.595	
3(2, 2) - 3(1, 2)E		136142.215(2.694)	0.366	1.170	0.428	10.136	5.595	
3(2, 2) - 3(1, 3)E		142688.669(2.588)	0.634	1.094	0.694	10.136	5.377	
3(2, 1) - 3(1, 3)E		145025.302(2.431)	0.366	1.094	0.401	10.214	5.377	
3(3, 1) - 3(2, 2)E		234466.537(5.377)	1.000	0.672	0.671	17.957	10.136	
4(2, 2) - 3(2, 1)E		77125.041(0.730)	0.998	19.507	19.478	12.787	10.214	
4(2, 3) - 3(2, 1)E		74790.161(2.804)	0.002	19.507	0.029	12.709	10.214	
4(0, 4) - 3(0, 3)E		76866.102(1.001)	1.000	25.998	25.998	6.485	3.921	

Table 5. The microwave spectrum for the E-symmetry state of $^{12}CH_3{}^{12}CH^{16}O$—Continued

J' K'₋ K'₊ – J" K"₋ K"₊ S	Measured Transition Freq. Unc. (MHz)	Calculated Transition Freq. Unc. (MHz)	Line Strength Relative	Rig.Rotor $\mu_x^2\ {}^xS_{J';J''}$	Total	Energy Levels Upper (cm^{-1})	Lower	Ref.
4(3, 1) - 3(3, 0)E		77082.357(0.782)	1.000	11.380	11.380	20.599	18.027	
4(1, 3) - 3(1, 2)E		79098.647(0.955)	0.998	24.383	24.331	8.233	5.595	
4(1, 4) - 3(1, 2)E		68377.288(1.000)	0.002	24.383	0.052	7.876	5.595	
4(3, 2) - 3(3, 1)E		77095.549(0.782)	1.000	11.380	11.380	20.529	17.957	
4(1, 4) - 3(1, 3)E		74923.742(0.906)	0.998	24.383	24.331	7.876	5.377	
4(1, 3) - 3(1, 3)E		85645.101(1.185)	0.002	24.383	0.052	8.233	5.377	
4(2, 3) - 3(2, 2)E		77126.793(0.715)	0.998	19.507	19.478	12.709	10.136	
4(2, 2) - 3(2, 2)E		79461.673(2.721)	0.002	19.507	0.029	12.787	10.136	
4(2, 2) - 3(1, 3)E		222150.342(2.780)	0.442	1.327	0.586	12.787	5.377	
4(2, 3) - 3(1, 3)E		219815.462(2.948)	0.558	1.327	0.740	12.709	5.377	
3(3, 1) - 4(2, 2)E		155004.863(6.106)	0.003	0.096	0.000	17.957	12.787	
3(3, 1) - 4(2, 3)E		157339.743(5.378)	0.997	0.096	0.095	17.957	12.709	
4(0, 4) - 3(1, 3)E	33236.469(0.020)	33238.346(0.856)	0.987	1.232	1.215	6.485	5.377	75A
4(0, 4) - 3(1, 2)E		26691.892(0.754)	0.013	1.232	0.017	6.485	5.595	
3(2, 2) - 4(1, 3)E		57043.568(2.239)	0.449	0.301	0.135	10.136	8.233	
3(2, 2) - 4(1, 4)E		67764.927(2.280)	0.551	0.301	0.166	10.136	7.876	
4(1, 4) - 3(0, 3)E		118551.498(1.587)	0.995	1.924	1.915	7.876	3.921	
4(1, 3) - 3(0, 3)E		129272.857(1.706)	0.005	1.924	0.009	8.233	3.921	
4(2, 3) - 3(1, 2)E		213269.009(3.022)	0.442	1.423	0.629	12.709	5.595	
4(2, 2) - 3(1, 2)E		215603.889(2.722)	0.558	1.423	0.794	12.787	5.595	
3(2, 1) - 4(1, 4)E		70101.560(1.994)	0.449	0.268	0.121	10.214	7.876	
3(2, 1) - 4(1, 3)E		59380.201(2.115)	0.551	0.268	0.148	10.214	8.233	
3(3, 0) - 4(2, 3)E		159447.200(6.381)	0.003	0.096	0.000	18.027	12.709	
3(3, 0) - 4(2, 2)E		157112.321(5.547)	0.997	0.096	0.095	18.027	12.787	
4(1, 3) - 4(1, 4)E	10720.629(0.020)	10721.359(0.733)	0.980	2.928	2.870	8.233	7.876	75A
4(2, 3) - 4(0, 4)E		186577.116(3.034)	0.558	0.017	0.009	12.709	6.485	
4(2, 2) - 4(0, 4)E		188911.996(2.740)	0.442	0.017	0.007	12.787	6.485	
4(3, 1) - 4(2, 2)E		234194.678(5.244)	0.997	1.214	1.210	20.599	12.787	
4(3, 2) - 4(2, 2)E		232100.413(5.814)	0.003	1.214	0.004	20.529	12.787	
4(1, 3) - 4(0, 4)E		52406.755(0.914)	0.995	3.232	3.216	8.233	6.485	
4(1, 4) - 4(0, 4)E		41685.396(0.836)	0.005	3.232	0.016	7.876	6.485	
4(2, 2) - 4(1, 3)E		136505.242(2.219)	0.627	1.676	1.051	12.787	8.233	
4(2, 3) - 4(1, 3)E		134170.362(2.391)	0.373	1.676	0.625	12.709	8.233	
4(2, 3) - 4(1, 4)E		144891.720(2.452)	0.627	1.503	0.942	12.709	7.876	
4(2, 2) - 4(1, 4)E		147226.600(2.156)	0.373	1.503	0.561	12.787	7.876	
4(3, 2) - 4(2, 3)E		234435.292(5.070)	0.997	1.213	1.209	20.529	12.709	
4(3, 1) - 4(2, 3)E		236529.557(6.074)	0.003	1.213	0.004	20.599	12.709	
5(4, 1) - 4(4, 0)E	96353.125(0.125)	96353.741(1.966)	1.000	11.705	11.705	34.746	31.532	
5(2, 3) - 4(2, 2)E	96475.500(0.125)	96474.655(0.804)	0.994	27.309	27.153	16.005	12.787	
5(2, 4) - 4(2, 2)E		94091.216(2.592)	0.006	27.309	0.156	15.925	12.787	
5(0, 5) - 4(0, 4)E	95947.340(0.130)	95946.932(1.050)	1.000	32.488	32.488	9.686	6.485	
5(3, 2) - 4(3, 1)E	96368.050(0.250)	96368.222(1.049)	1.000	20.808	20.808	23.813	20.599	
5(1, 4) - 4(1, 3)E	98863.270(0.140)	98862.654(0.976)	0.999	31.208	31.191	11.531	8.233	
5(3, 3) - 4(3, 2)E	96384.300(0.125)	96384.948(1.047)	1.000	20.808	20.808	23.744	20.529	
5(1, 5) - 4(1, 4)E	93595.276(0.100)	93594.554(0.952)	0.999	31.208	31.191	10.998	7.876	
5(4, 2) - 4(4, 1)E	96360.730(0.125)	96360.862(1.966)	1.000	11.705	11.705	34.716	31.502	
5(2, 4) - 4(2, 3)E	96425.750(0.125)	96426.096(0.776)	0.994	27.309	27.152	15.925	12.709	
5(2, 3) - 4(2, 3)E		98809.534(2.510)	0.006	27.309	0.156	16.005	12.709	
5(2, 3) - 4(1, 4)E		243701.255(2.530)	0.564	1.423	0.802	16.005	7.876	
5(2, 4) - 4(1, 4)E		241317.816(2.792)	0.436	1.423	0.621	15.925	7.876	
4(3, 2) - 5(2, 3)E		135625.758(5.699)	0.018	0.229	0.004	20.529	16.005	
4(3, 2) - 5(2, 4)E		138009.197(5.066)	0.982	0.229	0.225	20.529	15.925	
5(0, 5) - 4(1, 4)E		54261.536(0.953)	0.995	1.693	1.685	9.686	7.876	
5(0, 5) - 4(1, 3)E		43540.177(0.922)	0.005	1.693	0.008	9.686	8.233	
4(4, 1) - 5(3, 3)E		232585.193(15.336)	1.000	0.077	0.077	31.502	23.744	
4(2, 3) - 5(1, 4)E	35312.355(0.020)	35307.707(2.004)	0.512	0.492	0.251	12.709	11.531	75A
4(2, 3) - 5(1, 5)E		51297.166(2.176)	0.488	0.492	0.240	12.709	10.998	
5(1, 5) - 4(0, 4)E		135279.950(1.574)	0.998	2.347	2.342	10.998	6.485	
5(1, 4) - 4(0, 4)E		151269.409(1.710)	0.002	2.347	0.005	11.531	6.485	
5(2, 4) - 4(1, 3)E		230596.457(2.734)	0.564	1.603	0.904	15.925	8.233	
5(2, 3) - 4(1, 3)E		232979.896(2.547)	0.436	1.603	0.700	16.005	8.233	
4(4, 0) - 5(3, 2)E		231420.155(15.193)	1.000	0.077	0.077	31.532	23.813	
4(2, 2) - 5(1, 5)E		53632.046(1.769)	0.512	0.413	0.211	12.787	10.998	
4(2, 2) - 5(1, 4)E		37642.587(2.001)	0.488	0.413	0.202	12.787	11.531	
4(3, 1) - 5(2, 4)E		140103.462(6.016)	0.018	0.229	0.004	20.599	15.925	

Table 5. The microwave spectrum for the E-symmetry state of $^{12}CH_3{}^{12}CH^{16}O$–Continued

J' K'₋ K'₊ – J" K"₋ K"₊ S	Measured Transition Freq. Unc. (MHz)	Calculated Transition Freq. Unc. (MHz)	Line Strength Relative	Rig.Rotor μ_x^2 $^xS_{J';J"}$	Total	Energy Levels Upper (cm⁻¹)	Lower (cm⁻¹)	Ref.
4(3, 1) – 5(2, 3)E		137720.023(5.265)	0.982	0.229	0.225	20.599	16.005	
5(1, 4) – 5(1, 5)E	15988.730(0.020)	15989.459(1.001)	0.991	2.387	2.367	11.531	10.998	75A
5(2, 4) – 5(0, 5)E		187056.280(2.766)	0.632	0.032	0.020	15.925	9.686	
5(2, 3) – 5(0, 5)E		189439.719(2.462)	0.368	0.032	0.012	16.005	9.686	
5(3, 2) – 5(2, 3)E		234088.245(4.976)	0.983	1.704	1.674	23.813	16.005	
5(3, 3) – 5(2, 3)E		232010.706(5.413)	0.017	1.704	0.030	23.744	16.005	
5(1, 4) – 5(0, 5)E		55322.477(0.968)	0.998	3.832	3.824	11.531	9.686	
5(1, 5) – 5(0, 5)E		39333.018(0.851)	0.002	3.832	0.008	10.998	9.686	
5(2, 3) – 5(1, 4)E		134117.242(2.052)	0.677	2.205	1.492	16.005	11.531	
5(2, 4) – 5(1, 4)E		131733.803(2.135)	0.323	2.205	0.713	15.925	11.531	
5(2, 4) – 5(1, 5)E		147723.262(2.292)	0.677	1.878	1.271	15.925	10.998	
5(2, 3) – 5(1, 5)E		150106.701(1.906)	0.323	1.878	0.607	16.005	10.998	
5(3, 3) – 5(2, 4)E		234394.145(4.772)	0.983	1.701	1.671	23.744	15.925	
5(3, 2) – 5(2, 4)E		236471.683(5.718)	0.017	1.701	0.030	23.813	15.925	
6(4, 2) – 5(4, 1)E	115634.000(5.000)	115635.386(2.634)	1.000	21.676	21.676	38.604	34.746	
6(2, 4) – 5(2, 3)E		115909.239(0.944)	0.986	34.677	34.190	19.871	16.005	
6(2, 5) – 5(2, 3)E		113312.161(2.289)	0.014	34.677	0.487	19.784	16.005	
6(0, 6) – 5(0, 5)E	114939.900(0.100)	114939.448(1.029)	1.000	38.972	38.972	13.520	9.686	75B
6(5, 1) – 5(5, 0)E		115620.900(4.281)	1.000	11.922	11.922	52.692	48.835	
6(3, 3) – 5(3, 2)E	115664.200(0.200)	115664.305(1.458)	1.000	29.262	29.261	27.671	23.813	
6(1, 5) – 5(1, 4)E	118591.770(0.150)	118591.256(0.966)	1.000	37.923	37.917	15.487	11.531	75B
6(5, 2) – 5(5, 1)E		115627.323(4.282)	1.000	11.922	11.922	52.669	48.812	
6(3, 4) – 5(3, 3)E	115683.800(0.200)	115684.678(1.454)	1.000	29.262	29.261	27.603	23.744	
6(1, 6) – 5(1, 5)E	112254.480(0.160)	112253.577(0.945)	1.000	37.924	37.918	14.742	10.998	75B
6(4, 3) – 5(4, 2)E	115643.900(0.200)	115644.117(2.634)	1.000	21.676	21.676	38.574	34.716	
6(2, 5) – 5(2, 4)E	115693.000(5.000)	115695.600(0.914)	0.986	34.677	34.189	19.784	15.925	
6(2, 4) – 5(2, 4)E		118292.677(2.229)	0.014	34.677	0.487	19.871	15.925	
5(3, 3) – 6(2, 4)E		116101.467(5.199)	0.063	0.381	0.024	23.744	19.871	
5(3, 3) – 6(2, 5)E		118698.545(4.675)	0.937	0.381	0.357	23.744	19.784	
6(0, 6) – 5(1, 5)E		75606.430(1.045)	0.998	2.189	2.185	13.520	10.998	
6(0, 6) – 5(1, 4)E		59616.971(1.098)	0.002	2.189	0.005	13.520	11.531	
5(4, 2) – 6(3, 4)E		213261.377(14.959)	1.000	0.191	0.191	34.716	27.603	
5(2, 4) – 6(1, 5)E	13145.877(0.050)	13142.547(1.818)	0.600	0.698	0.419	15.925	15.487	75A
5(2, 4) – 6(1, 6)E	35472.152(0.020)	35469.685(2.073)	0.400	0.698	0.279	15.925	14.742	75A
6(1, 6) – 5(0, 5)E		151586.595(1.542)	0.999	2.797	2.794	14.742	9.686	
6(1, 5) – 5(0, 5)E		173913.733(1.654)	0.001	2.797	0.003	15.487	9.686	
6(2, 5) – 5(1, 4)E		247429.403(2.554)	0.700	1.797	1.259	19.784	11.531	
6(2, 4) – 5(1, 4)E		250026.480(2.434)	0.300	1.797	0.539	19.871	11.531	
5(4, 1) – 6(3, 3)E		212109.591(14.807)	1.000	0.191	0.191	34.746	27.671	
5(2, 3) – 6(1, 6)E	37851.405(0.020)	37853.124(1.580)	0.600	0.545	0.327	16.005	14.742	75A
5(2, 3) – 6(1, 5)E	15525.099(0.050)	15525.986(1.865)	0.400	0.545	0.218	16.005	15.487	75A
5(3, 2) – 6(2, 5)E		120776.084(5.531)	0.063	0.380	0.024	23.813	19.784	
5(3, 2) – 6(2, 4)E		118179.006(4.949)	0.937	0.380	0.356	23.813	19.871	
6(1, 5) – 6(1, 6)E	22326.171(0.020)	22327.138(1.264)	0.996	2.018	2.010	15.487	14.742	75A
6(2, 4) – 6(2, 5)E		2597.077(1.866)	0.234	8.001	1.875	19.871	19.784	
6(2, 5) – 6(0, 6)E		187812.432(2.601)	0.742	0.053	0.039	19.784	13.520	
6(2, 4) – 6(0, 6)E		190409.509(2.310)	0.258	0.053	0.014	19.871	13.520	
6(3, 3) – 6(2, 4)E		233843.311(4.831)	0.939	2.170	2.039	27.671	19.871	
6(3, 4) – 6(2, 4)E		231786.146(5.071)	0.061	2.170	0.132	27.603	19.871	
6(1, 5) – 6(0, 6)E		58974.285(1.042)	0.999	4.363	4.359	15.487	13.520	
6(1, 6) – 6(0, 6)E		36647.146(0.917)	0.001	4.363	0.005	14.742	13.520	
6(2, 4) – 6(1, 5)E		131435.224(1.926)	0.770	2.774	2.137	19.871	15.487	
6(2, 5) – 6(1, 5)E		128838.147(1.990)	0.230	2.774	0.637	19.784	15.487	
6(2, 5) – 6(1, 6)E		151165.285(2.161)	0.770	2.228	1.716	19.784	14.742	
6(2, 4) – 6(1, 6)E		153762.363(1.773)	0.230	2.228	0.511	19.871	14.742	
6(3, 4) – 6(2, 5)E		234383.223(4.560)	0.939	2.163	2.032	27.603	19.784	
6(3, 3) – 6(2, 5)E		236440.389(5.386)	0.061	2.163	0.131	27.671	19.784	
7(6, 1) – 6(6, 0)E		134876.425(7.832)	1.000	12.076	12.076	74.442	69.943	
7(4, 3) – 6(4, 2)E		134922.972(3.495)	1.000	30.655	30.655	43.104	38.604	
7(2, 5) – 6(2, 4)E		135475.616(1.287)	0.980	41.797	40.968	24.390	19.871	
7(2, 6) – 6(2, 4)E		132298.948(2.041)	0.020	41.797	0.829	25.284	19.871	
7(0, 7) – 6(0, 6)E		133829.493(1.057)	1.000	45.451	45.451	17.984	13.520	
7(5, 2) – 6(5, 1)E		134899.454(5.426)	1.000	22.295	22.295	57.192	52.692	
7(3, 4) – 6(3, 3)E		134972.773(2.080)	1.000	37.157	37.156	32.173	27.671	
7(1, 6) – 6(1, 5)E		138284.210(1.125)	1.000	44.575	44.572	20.099	15.487	

Table 5. The microwave spectrum for the E-symmetry state of $^{12}CH_3{}^{12}CH^{16}O$—Continued

J' K'₋ K'₊ - J" K"₋ K"₊ S	Measured Transition Freq. Unc. (MHz)	Calculated Transition Freq. Unc. (MHz)	Line Strength Relative	Rig.Rotor $\mu_x^2\ {}^xS_{J';J''}$	Total	Energy Levels Upper (cm^{-1})	Lower (cm^{-1})	Ref.
7(5, 3) - 6(5, 2)E		134906.775(5.427)	1.000	22.295	22.295	57.169	52.669	
7(3, 5) - 6(3, 4)E		134996.743(2.073)	1.000	37.157	37.156	32.106	27.603	
7(1, 7) - 6(1, 6)E		130891.566(1.000)	1.000	44.578	44.574	19.108	14.742	
7(6, 2) - 6(6, 1)E		134897.925(7.828)	1.000	12.076	12.076	74.377	69.877	
7(4, 4) - 6(4, 3)E		134933.413(3.495)	1.000	30.655	30.655	43.075	38.574	
7(2, 6) - 6(2, 5)E		134896.025(1.297)	0.980	41.796	40.967	24.284	19.784	
7(2, 5) - 6(2, 5)E		138072.693(1.998)	0.020	41.796	0.829	24.390	19.784	
6(3, 4) - 7(2, 5)E		96310.530(4.615)	0.150	0.543	0.082	27.603	24.390	
6(3, 4) - 7(2, 6)E		99487.198(4.195)	0.850	0.543	0.461	27.603	24.284	
7(0, 7) - 6(1, 6)E	97180.650(0.125)	97182.347(1.181)	0.999	2.724	2.721	17.984	14.742	
7(0, 7) - 6(1, 5)E		74855.208(1.289)	0.001	2.724	0.003	17.984	15.487	
6(4, 3) - 7(3, 5)E		193908.751(14.476)	1.000	0.327	0.327	32.106	38.574	
7(1, 6) - 6(2, 5)E	9443.908(0.050)	9446.063(1.723)	0.720	0.921	0.663	20.099	19.784	75A
6(2, 5) - 7(1, 7)E		20273.720(1.937)	0.280	0.921	0.258	19.784	19.108	
7(1, 7) - 6(0, 6)E		167538.712(1.597)	0.999	3.279	3.277	19.108	13.520	
6(4, 2) - 7(3, 4)E		192772.204(14.316)	1.000	0.327	0.327	38.604	32.173	
6(2, 4) - 7(1, 7)E	22868.978(0.020)	22870.797(1.440)	0.720	0.658	0.474	19.871	19.108	75A
7(1, 6) - 6(2, 4)E		6848.986(1.725)	0.280	0.685	0.184	20.099	19.871	
6(3, 3) - 7(2, 6)E		101544.363(4.915)	0.150	0.540	0.081	27.671	24.284	
6(3, 3) - 7(2, 5)E		98367.696(4.599)	0.850	0.540	0.459	27.671	24.390	
7(1, 6) - 7(1, 7)E	29718.416(0.020)	29719.783(1.494)	0.998	1.751	1.747	20.099	19.108	75A
7(2, 5) - 7(2, 6)E		3176.668(1.334)	0.503	6.892	3.464	24.390	24.284	
7(2, 6) - 7(0, 7)E		188878.964(2.685)	0.854	0.082	0.070	24.284	17.984	
7(2, 5) - 7(0, 7)E		192055.631(2.453)	0.146	0.082	0.012	24.390	17.984	
7(3, 4) - 7(2, 5)E		233340.469(4.922)	0.860	2.628	2.259	32.173	24.390	
7(3, 5) - 7(2, 5)E		231307.273(4.929)	0.140	2.628	0.369	32.106	24.390	
7(1, 6) - 7(0, 7)E		63429.001(1.148)	0.999	4.816	4.813	20.099	17.984	
7(2, 5) - 7(1, 6)E		128626.630(1.943)	0.871	3.391	2.955	24.390	20.099	
7(2, 6) - 7(1, 6)E		125449.962(2.063)	0.129	3.391	0.436	24.284	20.099	
7(2, 6) - 7(1, 7)E		155169.745(2.195)	0.871	2.553	2.225	24.284	19.108	
7(2, 5) - 7(1, 7)E		158346.413(1.922)	0.129	2.553	0.328	24.390	19.108	
7(3, 5) - 7(2, 6)E		234483.941(4.540)	0.860	2.612	2.245	32.106	24.284	
7(3, 4) - 7(2, 6)E		236517.137(5.183)	0.140	2.612	0.367	32.173	24.284	
8(6, 2) - 7(6, 1)E		154150.809(9.543)	1.000	22.759	22.759	79.584	74.442	
8(4, 4) - 7(4, 3)E		154217.492(4.596)	1.000	39.016	39.016	48.248	43.104	
8(2, 6) - 7(2, 5)E		155178.601(1.943)	0.985	48.762	48.009	29.566	25.390	
8(2, 7) - 7(2, 5)E		150850.048(2.293)	0.015	48.762	0.753	29.422	24.390	
8(0, 8) - 7(0, 7)E		152606.294(1.360)	1.000	51.923	51.923	23.074	17.984	
8(7, 1) - 7(7, 0)E		154131.590(12.809)	1.000	12.193	12.193	99.950	94.809	
8(5, 3) - 7(5, 2)E		154181.882(6.799)	1.000	31.701	31.701	62.335	57.192	
8(3, 5) - 7(3, 4)E		154296.089(2.967)	1.000	44.705	44.698	37.320	32.173	
8(1, 7) - 7(1, 6)E		157936.812(1.684)	1.000	51.186	51.185	25.368	20.099	
8(7, 2) - 7(7, 1)E		154161.011(12.798)	1.000	12.193	12.193	99.872	94.729	
8(5, 4) - 7(5, 3)E		154190.021(6.799)	1.000	31.701	31.701	62.312	57.169	
8(3, 6) - 7(3, 5)E		154322.920(2.958)	1.000	44.705	44.698	37.253	32.106	
8(1, 8) - 7(1, 7)E		149503.676(1.327)	1.000	51.191	51.191	24.095	19.108	
8(6, 3) - 7(6, 2)E		154175.244(9.538)	1.000	22.759	22.759	79.520	74.377	
8(4, 5) - 7(4, 4)E		154229.756(4.594)	1.000	39.016	39.016	48.219	43.075	
8(2, 7) - 7(2, 6)E		154026.716(1.993)	0.985	48.759	48.006	29.422	24.284	
8(2, 6) - 7(2, 6)E		158355.269(2.179)	0.015	48.759	0.753	29.566	24.284	
7(3, 5) - 8(2, 6)E		76128.672(3.967)	0.254	0.710	0.181	32.106	29.566	
7(3, 5) - 8(2, 7)E		80457.225(3.627)	0.746	0.710	0.530	32.106	29.422	
8(0, 8) - 7(1, 7)E		118897.076(1.520)	0.999	3.301	3.299	23.074	19.108	
7(4, 4) - 8(3, 6)E		174519.244(13.877)	1.000	0.476	0.476	37.253	43.075	
8(1, 7) - 7(2, 6)E	32486.073(0.020)	32486.850(1.867)	0.841	1.161	0.976	25.368	24.284	75A
7(2, 6) - 8(1, 8)E		5666.069(1.763)	0.159	1.161	0.185	24.284	24.095	
8(1, 8) - 7(0, 7)E		183212.895(1.907)	1.000	3.797	3.795	24.095	17.984	
7(4, 3) - 8(3, 5)E		173399.086(13.710)	1.000	0.476	0.476	43.104	37.320	
7(2, 5) - 8(1, 8)E	8840.555(0.050)	8842.736(1.390)	0.841	0.747	0.628	24.390	24.095	75A
8(1, 7) - 7(2, 5)E	29310.400(0.100)	29310.182(1.795)	0.159	0.747	0.119	25.368	24.390	75A
7(3, 4) - 8(2, 7)E		82490.421(4.206)	0.254	0.703	0.179	32.173	29.422	
7(3, 4) - 8(2, 6)E		78161.867(4.176)	0.746	0.703	0.524	32.173	29.566	
8(1, 7) - 8(1, 8)E	38150.985(0.020)	38152.918(1.795)	0.999	1.550	1.547	25.368	24.095	75A
8(2, 6) - 8(2, 7)E		4328.554(0.959)	0.741	6.035	4.473	29.566	29.422	
8(2, 7) - 8(0, 8)E		190299.385(3.154)	0.930	0.117	0.109	29.422	23.074	

Table 5. The microwave spectrum for the E-symmetry state of $^{12}CH_3{}^{12}CH^{16}O$—Continued

J' K'_- K'_+ - J" K''_- K''_+ S	Measured Transition Freq. (MHz)	Measured Transition Unc.	Calculated Transition Freq. (MHz)	Calculated Transition Unc.	Line Strength Relative	Line Strength Rig.Rotor μ_x^2 $^xS_{J';J''}$	Line Strength Total	Energy Levels Upper (cm^{-1})	Energy Levels Lower (cm^{-1})	Ref.
8(2, 6) - 8(0, 8)E			194627.939	2.986	0.070	0.117	0.008	29.566	23.074	
8(3, 5) - 8(2, 6)E			232457.956	5.307	0.773	3.084	2.384	37.320	29.566	
8(3, 6) - 8(2, 6)E			230451.592	5.141	0.227	3.084	0.700	37.253	29.566	
8(1, 7) - 8(0, 8)E			68759.519	1.354	1.000	5.183	5.181	25.368	23.074	
8(2, 6) - 8(1, 7)E			125868.419	2.232	0.940	4.060	3.816	29.566	25.368	
8(2, 7) - 8(1, 7)E			121539.866	2.401	0.060	4.060	0.244	29.422	25.368	
8(2, 7) - 8(1, 8)E			159692.784	2.600	0.940	2.855	2.683	29.422	24.095	
8(2, 6) - 8(1, 8)E			164021.338	2.440	0.060	2.855	0.172	29.566	24.095	
8(3, 6) - 8(2, 7)E			234780.145	4.832	0.773	3.053	2.360	37.253	29.422	
8(3, 5) - 8(2, 7)E			236786.510	5.281	0.22	3.053	0.693	37.320	29.422	
9(8, 1) - 8(8, 0)E			173391.504	19.418	1.000	12.283	12.283	129.202	123.418	
9(6, 3) - 8(6, 2)E			173427.717	11.515	1.000	32.513	32.513	85.369	79.584	
9(4, 5) - 8(4, 4)E			173519.944	5.980	1.000	46.963	46.963	54.036	48.248	
9(2, 7) - 8(2, 6)E			174981.672	2.982	0.992	55.625	55.187	35.403	29.566	
9(2, 8) - 8(2, 6)E			168795.091	3.243	0.008	55.625	0.438	35.197	29.566	
9(0, 9) - 8(0, 8)E			171263.786	2.066	1.000	58.390	58.390	28.787	23.074	
9(7, 2) - 8(7, 1)E			173402.479	15.178	1.000	23.121	23.121	105.734	99.950	
9(5, 4) - 8(5, 3)E			173468.734	8.441	1.000	40.461	40.461	68.121	62.335	
9(3, 6) - 8(3, 5)E			173637.537	4.158	0.999	52.019	51.993	43.112	37.320	
9(1, 8) - 8(1, 7)E			177542.447	2.684	1.000	57.769	57.768	31.290	25.368	
9(7, 3) - 8(7, 2)E			173435.538	15.166	1.000	23.121	23.121	105.657	99.872	
9(5, 5) - 8(5, 4)E			173477.600	8.441	1.000	40.461	40.461	58.099	62.312	
9(3, 7) - 8(3, 6)E			173664.272	4.149	0.999	52.019	51.993	43.046	37.253	
9(1, 9) - 8(1, 8)E			168086.873	2.036	1.000	57.777	57.776	29.702	25.095	
9(8, 2) - 8(8, 1)E			173415.064	19.406	1.000	12.283	12.283	129.146	123.362	
9(6, 4) - 8(6, 3)E			173455.030	11.509	1.000	32.513	32.513	85.305	79.520	
9(4, 6) - 8(4, 5)E			173534.158	5.978	1.000	46.963	46.963	54.008	48.219	
9(2, 8) - 8(2, 7)E			173123.644	3.021	0.992	55.618	55.180	35.197	29.422	
9(2, 7) - 8(2, 7)E			179310.226	3.006	0.008	55.618	0.438	35.403	29.422	
8(5, 4) - 9(4, 5)E			248114.233	31.860	1.000	0.424	0.424	62.312	54.036	
8(3, 6) - 9(2, 7)E			55469.919	3.257	0.347	0.881	0.305	37.253	35.403	
8(3, 6) - 9(2, 8)E			61656.501	2.999	0.653	0.881	0.576	37.253	35.197	
9(0, 9) - 8(1, 8)E			140657.185	2.203	1.000	3.919	3.918	28.787	24.095	
8(4, 5) - 9(3, 6)E			153105.098	13.583	0.002	0.634	0.001	48.219	43.112	
8(4, 5) - 9(3, 7)E			155084.727	13.149	0.998	0.634	0.632	48.219	43.046	
9(1, 8) - 8(2, 7)E			56002.581	2.427	0.923	1.420	1.310	31.290	29.422	
9(1, 9) - 8(2, 7)E			8294.088	1.637	0.077	1.420	0.110	29.702	29.422	
9(1, 9) - 8(0, 8)E			198693.473	2.585	1.000	4.354	4.353	29.702	23.074	
8(4, 4) - 9(3, 7)E			155958.670	13.859	0.002	0.634	0.001	48.248	43.046	
8(4, 4) - 9(3, 6)E			153979.041	12.979	0.998	0.634	0.632	48.248	43.112	
9(1, 9) - 8(2, 6)E			4065.535	1.437	0.923	0.809	0.746	29.702	29.566	
9(1, 8) - 8(2, 6)E			51674.027	2.410	0.077	0.809	0.063	31.290	29.566	
8(5, 3) - 9(4, 6)E			249646.845	32.090	1.000	0.424	0.424	62.335	54.008	
8(3, 5) - 9(2, 8)E			63662.865	3.449	0.347	0.866	0.300	37.320	35.197	
8(3, 5) - 9(2, 7)E			57476.284	3.627	0.653	0.866	0.566	37.320	35.403	
9(1, 8) - 9(1, 9)E			47608.493	2.385	0.999	1.393	1.392	31.290	29.702	
9(2, 7) - 9(2, 8)E			6186.582	0.948	0.879	5.347	4.697	35.403	35.197	
9(2, 8) - 9(0, 9)E			192159.243	4.007	0.969	0.160	0.155	35.197	28.787	
9(2, 7) - 9(0, 9)E			198345.825	3.856	0.031	0.160	0.005	35.403	28.787	
9(3, 6) - 9(2, 7)E			231113.821	5.983	0.715	3.545	2.536	43.112	35.403	
9(3, 7) - 9(2, 7)E			229134.192	5.758	0.285	3.545	1.009	43.046	35.403	
9(1, 8) - 9(0, 9)E			75038.180	1.816	1.000	5.461	5.460	31.290	28.787	
9(2, 7) - 9(1, 8)E			123307.645	2.788	0.974	4.781	4.656	35.403	31.290	
9(2, 8) - 9(1, 8)E			117121.063	2.943	0.026	4.781	0.126	35.197	31.290	
9(2, 8) - 9(1, 9)E			164729.556	3.455	0.974	3.133	3.050	35.197	29.702	
9(2, 7) - 9(1, 9)E			170916.138	3.306	0.026	3.133	0.082	35.403	29.702	
9(3, 7) - 9(2, 8)E			235320.773	5.507	0.715	3.489	2.497	43.046	35.197	
9(3, 6) - 9(2, 8)E			237300.403	5.797	0.285	3.489	0.993	43.112	35.197	
10(8, 2) - 9(8, 1)E			192659.804	22.538	1.000	23.410	23.410	135.628	129.202	
10(6, 4) - 9(6, 3)E			192707.464	13.788	1.000	41.617	41.617	91.797	85.369	
10(4, 6) - 9(4, 5)E			192831.337	7.690	1.000	54.622	54.622	60.468	54.036	
10(2, 8) - 9(2, 7)E			194858.843	4.431	0.997	62.417	62.209	41.903	35.403	
10(2, 9) - 9(2, 7)E			186019.860	4.670	0.003	62.417	0.208	41.608	35.403	
10(0,10) - 9(0, 9)E			189801.699	3.156	1.000	64.853	64.853	35.118	28.787	
10(9, 1) - 9(9, 0)E			192659.134	27.873	1.000	12.355	12.355	162.192	155.766	

Table 5. The microwave spectrum for the E-symmetry state of $^{12}CH_3{}^{12}CH^{16}O$—Continued

$J'\ K'_-\ K'_+\ -\ J''\ K''_-\ K''_+$ S	Measured Transition Freq. Unc. (MHz)	Calculated Transition Freq. Unc. (MHz)	Line Strength Relative	Line Strength Rig.Rotor $\mu_x^2\ {}^xS_{J';J''}$	Line Strength Total	Energy Levels Upper (cm^{-1})	Energy Levels Lower (cm^{-1})	Ref.
10(7, 3) - 9(7, 2)E		192674.933(17.840)	1.000	33.164	33.164	112.161	105.734	
10(5, 5) - 9(5, 4)E		192760.562(10.396)	1.000	48.770	48.770	74.551	68.121	
10(3, 7) - 9(3, 6)E		193002.396(5.689)	0.998	59.171	59.081	49.550	43.112	
10(3, 8) - 9(3, 6)E		191040.385(6.416)	0.002	59.171	0.091	49.485	43.112	
10(1, 9) - 9(1, 8)E		197093.293(4.099)	1.000	64.330	64.330	37.864	31.290	
10(9, 2) - 9(9, 1)E		192662.883(27.871)	1.000	12.355	12.355	162.185	155.758	
10(7, 4) - 9(7, 3)E		192711.609(17.827)	1.000	33.164	33.164	112.085	105.657	
10(5, 6) - 9(5, 5)E		192770.050(10.396)	1.000	48.770	48.770	74.529	68.099	
10(3, 8) - 9(3, 7)E		193020.014(5.684)	0.998	59.171	59.081	49.485	43.046	
10(3, 7) - 9(3, 7)E		194982.026(6.555)	0.002	59.171	0.091	49.550	43.046	
10(1,10) - 9(1, 9)E		186639.187(3.115)	1.000	64.344	64.343	35.927	29.702	
10(8, 3) - 9(8, 2)E		192686.104(22.525)	1.000	23.410	23.410	135.574	129.146	
10(6, 5) - 9(6, 4)E		192737.588(13.781)	1.000	41.617	41.617	91.735	85.305	
10(4, 7) - 9(4, 6)E		192847.632(7.687)	1.000	54.622	54.622	60.440	54.008	
10(2, 9) - 9(2, 8)E		192206.442(4.404)	0.997	62.404	62.195	41.608	35.197	
10(2, 8) - 9(2, 8)E		201045.425(4.391)	0.003	62.404	0.208	41.903	35.197	
9(5, 5) - 10(4, 6)E		228760.496(30.926)	1.000	0.572	0.572	68.099	60.468	
9(3, 7) - 10(2, 8)E	34274.578(0.020)	34275.349(2.534)	0.425	1.054	0.448	43.046	41.903	75A
9(3, 7) - 10(2, 9)E		43114.332(2.424)	0.575	1.054	0.606	43.046	41.608	
10(0,10) - 9(1, 9)E		162372.012(3.273)	1.000	4.578	4.577	35.118	29.702	
9(4, 6) - 10(3, 7)E		133636.860(12.685)	0.007	0.796	0.006	54.008	49.550	
9(4, 6) - 10(3, 8)E		135598.871(12.275)	0.993	0.796	0.791	54.008	49.485	
10(1, 9) - 9(2, 8)E		79972.230(3.480)	0.964	1.701	1.640	37.864	35.197	
10(1,10) - 9(2, 8)E		21909.631(1.711)	0.036	1.701	0.061	35.927	35.197	
10(1,10) - 9(0, 9)E		214068.874(3.646)	1.000	4.950	4.949	35.927	28.787	
9(4, 5) - 10(3, 8)E		136458.600(12.952)	0.007	0.796	0.006	54.036	49.485	
9(4, 5) - 10(3, 7)E		134496.589(12.114)	0.993	0.796	0.790	54.036	49.550	
10(1,10) - 9(2, 7)E	15727.190(0.020)	15723.049(1.543)	0.964	0.844	0.814	35.927	35.403	75A
10(1, 9) - 9(2, 7)E		73785.648(3.582)	0.036	0.844	0.030	37.864	35.403	
9(5, 4) - 10(4, 7)E		230267.947(31.168)	1.000	0.572	0.572	68.121	60.440	
9(3, 6) - 10(2, 9)E		45093.961(2.704)	0.425	1.026	0.436	43.112	41.608	
9(2, 6) - 10(2, 8)E		36254.978(2.967)	0.575	1.026	0.590	43.112	41.903	
10(1, 9) - 10(1,10)E		58062.599(3.521)	0.999	1.269	1.268	37.864	35.927	
10(2, 8) - 10(2, 9)E	8839.309(0.020)	8838.983(1.169)	0.943	4.779	4.508	41.903	41.608	75A
10(2, 9) - 10(0,10)E		194563.986(5.203)	0.986	0.210	0.207	41.608	35.118	
10(2, 8) - 10(0,10)E		203402.969(5.042)	0.014	0.210	0.003	41.903	35.118	
10(3, 7) - 10(2, 8)E		229257.374(6.924)	0.698	4.017	2.806	49.550	41.903	
10(3, 8) - 10(2, 8)E		227295.363(6.734)	0.302	4.017	1.211	49.485	41.903	
10(1, 9) - 10(0,10)E		82329.774(2.735)	1.000	5.652	5.652	37.864	35.118	
10(2, 8) - 10(1, 9)E		121073.195(3.527)	0.988	5.547	5.482	41.903	37.864	
10(2, 9) - 10(1, 9)E		112234.212(3.632)	0.012	5.547	0.064	41.608	37.864	
10(2, 9) - 10(1,10)E		170296.811(4.751)	0.988	3.387	3.347	41.608	35.927	
10(2, 8) - 10(1,10)E		179135.794(4.578)	0.012	3.387	0.039	41.903	35.927	
10(3, 8) - 10(2, 9)E		236134.346(6.570)	0.698	3.922	2.739	49.485	41.608	
10(3, 7) - 10(2, 9)E		238096.357(6.737)	0.302	3.922	1.183	49.550	41.608	
11(10, 1) - 10(10, 0)E		211910.667(38.405)	1.000	12.414	12.414	198.969	191.900	
11(8, 3) - 10(8, 2)E		211928.917(25.984)	1.000	33.696	33.696	142.697	135.628	
11(6, 5) - 10(6, 4)E		211990.363(16.404)	1.000	50.248	50.248	98.868	91.797	
11(4, 7) - 10(4, 6)E		212152.703(9.767)	1.000	62.070	62.069	67.545	60.468	
11(2, 9) - 10(2, 8)E		214799.959(6.313)	0.999	69.159	69.064	49.068	41.903	
11(2,10) - 10(2, 8)E		202433.637(6.433)	0.001	69.159	0.095	48.655	41.903	
11(0,11) - 10(0,10)E		208226.034(4.606)	1.000	71.314	71.314	42.064	35.118	
11(9, 2) - 10(9, 1)E		211925.706(31.838)	1.000	23.646	23.646	169.261	162.192	
11(7, 4) - 10(7, 3)E		211949.122(20.836)	1.000	42.563	42.563	119.231	112.161	
11(5, 6) - 10(5, 5)E		212057.918(12.705)	1.000	56.750	56.750	81.624	74.551	
11(3, 8) - 10(3, 7)E		212400.102(7.595)	0.996	66.205	65.945	56.635	49.550	
11(3, 9) - 10(3, 7)E		210423.356(8.066)	0.004	66.205	0.260	56.569	49.550	
11(1,10) - 10(1, 9)E		216580.553(5.928)	1.000	70.875	70.875	45.089	37.864	
11(9, 3) - 10(9, 2)E		211930.142(31.834)	1.000	23.646	23.646	169.254	162.185	
11(7, 5) - 10(7, 4)E		211989.392(20.821)	1.000	42.563	42.563	119.156	112.085	
11(5, 7) - 10(5, 6)E		212067.913(12.705)	1.000	56.750	56.750	81.603	74.529	
11(3, 9) - 10(3, 8)E		212385.367(7.602)	0.996	66.205	65.945	56.569	49.485	
11(3, 8) - 10(3, 8)E		214362.113(8.242)	0.004	66.205	0.260	56.635	49.485	
11(1,11) - 10(1,10)E		205159.468(4.551)	1.000	70.897	70.897	42.771	35.927	
11(10, 2) - 10(10, 1)E		211933.030(38.399)	1.000	12.414	12.414	198.925	191.856	

Table 5. The microwave spectrum for the E-symmetry state of $^{12}CH_3{}^{12}CH^{16}O$—Continued

$J'\ K'_-\ K'_+\ -\ J''\ K''_-\ K''_+\ S$	Measured Transition Freq. Unc. (MHz)	Calculated Transition Freq. Unc. (MHz)	Line Strength Relative	Rig.Rotor $\mu_x^2\ {}^xS_{J';J''}$	Total	Energy Levels Upper (cm^{-1})	Lower (cm^{-1})	Ref.
11(8, 4) - 10(8, 3)E		211957.989(25.969)	1.000	33.696	33.696	142.644	135.574	
11(6, 6) - 10(6, 5)E		212023.221(16.397)	1.000	50.248	50.248	98.807	91.735	
11(4, 8) - 10(4, 7)E		212171.197(9.762)	1.000	62.070	62.069	67.518	60.440	
11(2,10) - 10(2, 9)E		211272.619(6.163)	0.999	69.135	69.040	48.655	41.608	
11(2, 9) - 10(2, 9)E		223638.942(6.309)	0.001	69.135	0.095	49.068	41.608	
10(5, 6) - 11(4, 7)E		209377.843(29.827)	1.000	0.727	0.727	74.529	67.545	
10(3, 8) - 11(2, 9)E	12492.973(0.050)	12495.404(2.169)	0.501	1.228	0.615	49.485	49.068	75A
10(3, 8) - 11(2,10)E	24859.393(0.020)	24861.726(2.207)	0.499	1.228	0.613	49.485	48.655	75A
11(0,11) - 10(1,10)E		183958.859(4.728)	1.000	5.274	5.273	42.064	35.927	
10(4, 7) - 11(3, 8)E		114084.390(11.654)	0.022	0.962	0.021	60.440	56.635	
10(4, 7) - 11(3, 9)E		116061.136(11.239)	0.978	0.962	0.941	60.440	56.569	
11(1,10) - 10(2, 9)E		104346.341(5.061)	0.983	2.006	1.972	45.089	41.608	
11(1,11) - 10(2, 9)E		34862.657(2.175)	0.017	2.006	0.034	42.771	41.608	
11(1,11) - 10(0,10)E		229426.643(5.077)	1.000	5.585	5.585	42.771	35.118	
10(4, 6) - 11(3, 9)E		116904.570(11.874)	0.022	0.961	0.021	60.468	56.569	
10(4, 6) - 11(3, 8)E		114927.825(11.111)	0.978	0.961	0.940	60.468	56.635	
11(1,11) - 10(2, 8)E	26029.553(0.020)	26023.674(1.853)	0.983	0.852	0.837	42.771	41.903	75A
11(1,10) - 10(2, 8)E		95507.358(5.191)	0.017	0.852	0.014	45.089	41.903	
10(5, 5) - 11(4, 8)E		210857.313(30.083)	1.000	0.727	0.727	74.551	67.518	
10(3, 7) - 11(2,10)E	26823.146(0.020)	26823.738(2.179)	0.501	1.180	0.591	49.550	48.655	75A
10(3, 7) - 11(2, 9)E	14456.726(0.020)	14457.415(2.436)	0.499	1.180	0.589	49.550	49.068	75A
11(1,10) - 11(1,11)E		69483.684(5.379)	1.000	1.170	1.169	45.089	42.771	
11(2, 9) - 11(2,10)E	12366.328(0.020)	12366.322(1.509)	0.973	4.299	4.181	49.068	48.655	75A
11(2,10) - 11(0,11)E		197610.571(6.754)	0.993	0.264	0.262	48.655	42.064	
11(2, 9) - 11(0,11)E		209976.894(6.642)	0.007	0.264	0.002	49.068	42.064	
11(3, 8) - 11(2, 9)E		226857.517(8.095)	0.722	4.505	3.251	56.635	49.068	
11(3, 9) - 11(2, 9)E		224880.771(7.998)	0.278	4.505	1.254	56.569	49.068	
11(1,10) - 11(0,11)E		90684.293(4.284)	1.000	5.763	5.762	45.089	42.064	
11(2, 9) - 11(1,10)E		119292.601(4.379)	0.995	6.344	6.310	49.068	45.089	
11(2,10) - 11(1,10)E		106926.279(4.460)	0.005	6.344	0.034	48.655	45.089	
11(2,10) - 11(1,11)E		176409.963(6.514)	0.995	3.617	3.597	48.655	42.771	
11(2, 9) - 11(1,11)E		188776.285(6.421)	0.005	3.617	0.019	49.068	42.771	
11(3, 9) - 11(2,10)E		237247.093(7.982)	0.722	4.351	3.140	56.569	48.655	
11(3, 8) - 11(2,10)E		239223.839(8.050)	0.278	4.351	1.211	56.635	48.655	
12(10, 2) - 11(10, 1)E		231174.393(43.306)	1.000	23.843	23.843	206.680	198.969	
12(8, 4) - 11(8, 3)E		231198.922(29.795)	1.000	43.351	43.351	150.409	142.697	
12(6, 6) - 11(6, 5)E		231276.725(19.404)	1.000	58.524	58.524	106.583	98.868	
12(4, 8) - 11(4, 7)E		231485.122(12.248)	1.000	69.361	69.357	75.267	67.545	
12(2,10) - 11(2, 9)E		234794.378(8.663)	0.999	75.865	75.821	56.900	49.068	
12(0,12) - 11(0,11)E		226548.631(6.421)	1.000	77.776	77.776	49.620	42.064	
12(11, 1) - 11(11, 0)E		231165.045(51.225)	1.000	12.464	12.464	239.483	231.773	
12(9, 3) - 11(9, 2)E		231192.465(36.160)	1.000	34.139	34.139	176.973	169.261	
12(7, 5) - 11(7, 4)E		231225.221(24.206)	1.000	51.480	51.480	126.944	119.231	
12(5, 7) - 11(5, 6)E		231361.355(15.410)	1.000	64.484	64.484	89.342	81.624	
12(3, 9) - 11(3, 8)E		231846.680(9.912)	0.992	73.150	72.551	64.368	56.635	
12(3,10) - 11(3, 8)E		229772.370(10.235)	0.008	73.150	0.598	64.299	56.635	
12(1,11) - 11(1,10)E		235994.576(8.185)	1.000	77.405	77.405	52.960	45.089	
12(11, 2) - 11(11, 1)E		231207.219(51.211)	1.000	12.464	12.464	239.409	231.697	
12(9, 4) - 11(9, 3)E		231197.670(36.156)	1.000	34.139	34.139	176.966	169.254	
12(7, 6) - 11(7, 5)E		231269.052(24.190)	1.000	51.480	51.480	126.871	119.156	
12(5, 8) - 11(5, 7)E		231371.730(15.409)	1.000	64.484	64.484	89.321	81.603	
12(3,10) - 11(3, 9)E		231749.116(9.942)	0.992	73.149	72.551	64.299	56.569	
12(3, 9) - 11(3, 9)E		233823.426(10.402)	0.008	73.149	0.598	64.368	56.569	
12(1,12) - 11(1,11)E		223647.264(6.354)	1.000	77.439	77.439	50.231	42.771	
12(10, 3) - 11(10, 2)E		231198.342(43.301)	1.000	23.843	23.843	206.637	198.925	
12(8, 5) - 11(8, 4)E		231230.797(29.779)	1.000	43.351	43.351	150.357	142.644	
12(6, 7) - 11(6, 6)E		231312.232(19.396)	1.000	58.524	58.524	106.523	98.807	
12(4, 9) - 11(4, 8)E		231505.854(12.243)	1.000	69.361	69.357	75.240	67.518	
12(2,11) - 11(2,10)E		230314.310(8.321)	0.999	75.826	75.782	56.338	48.655	
11(5, 7) - 12(4, 8)E		189960.634(28.553)	1.000	0.887	0.887	81.603	75.267	
12(2,10) - 11(3, 9)E	9917.636(0.020)	9913.607(2.944)	0.587	1.405	0.825	56.900	56.569	75A
11(3, 9) - 12(2,11)E		6932.783(2.695)	0.413	1.405	0.580	56.569	56.338	
12(0,12) - 11(1,11)E		205348.022(6.566)	1.000	6.001	6.001	49.620	42.771	
11(4, 8) - 12(3, 9)E		94408.907(10.493)	0.058	1.130	0.066	67.518	64.368	
11(4, 8) - 12(3,10)E		96483.217(10.034)	0.942	1.130	1.064	67.518	64.299	

Table 5. The microwave spectrum for the E-symmetry state of $^{12}CH_3{}^{12}CH^{16}O$—Continued

J' K'_- K'_+ - J" K''_- K''_+ S	Measured Transition Freq. Unc. (MHz)	Calculated Transition Freq. Unc. (MHz)	Line Strength Relative	Rig.Rotor μ_x^2 $^xS_{J';J''}$	Total	Energy Levels Upper (cm^{-1})	Lower	Ref.
12(1,11) - 11(2,10)E		129068.298(7.205)	0.992	2.338	2.319	52.960	48.655	
12(1,12) - 11(2,10)E		47237.302(3.168)	0.008	2.338	0.020	50.231	48.655	
12(1,12) - 11(0,11)E		244847.873(6.877)	1.000	6.256	6.256	50.231	42.064	
11(4, 7) - 12(3,10)E		97308.157(10.607)	0.058	1.128	0.066	67.545	64.299	
11(4, 7) - 12(3, 9)E		95233.847(9.979)	0.942	1.128	1.062	67.545	64.368	
12(1,12) - 11(2, 9)E	34878.776(0.020)	34870.980(2.765)	0.992	0.836	0.829	50.231	49.068	75A
12(1,11) - 11(2, 9)E		116701.976(7.166)	0.008	0.836	0.007	52.960	49.068	
11(5, 6) - 12(4, 9)E		191409.377(28.824)	1.000	0.887	0.887	81.624	75.240	
11(3, 8) - 12(2,11)E	8908.261(0.050)	8909.529(2.341)	0.587	1.325	0.778	56.635	56.338	75A
12(2,10) - 11(3, 8)E	7937.634(0.050)	7936.861(2.803)	0.413	1.325	0.547	56.900	56.635	75A
12(3, 9) - 12(3,10)E		2074.310(2.785)	0.209	9.262	1.932	64.368	64.299	
12(1,11) - 12(1,12)E		81830.996(8.081)	1.000	1.090	1.089	52.960	50.231	
12(2,10) - 12(2,11)E	16846.003(0.020)	16846.391(2.065)	0.986	3.888	3.834	56.900	56.338	75A
12(2,11) - 12(0,12)E		201376.251(8.732)	0.997	0.321	0.320	56.338	49.620	
12(2,10) - 12(0,12)E		218222.641(8.882)	0.003	0.321	0.001	56.900	49.620	
12(3, 9) - 12(2,10)E		223909.819(9.469)	0.779	5.016	3.908	64.368	56.900	
13(3,10) - 12(2,10)E		221835.508(9.498)	0.221	5.016	1.108	64.299	56.900	
12(1,11) - 12(0,12)E		100130.239(6.614)	1.000	5.803	5.803	52.960	49.620	
12(2,10) - 12(1,11)E		118092.403(5.291)	0.997	7.154	7.136	56.900	52.960	
12(2,11) - 12(1,11)E		101246.012(5.449)	0.003	7.154	0.018	56.338	52.960	
12(2,11) - 12(1,12)E		183077.008(8.813)	0.997	3.823	3.814	56.338	50.231	
12(2,10) - 12(1,12)E		199923.399(9.067)	0.003	3.823	0.010	56.900	50.231	
12(3,10) - 12(2,11)E		238681.899(9.697)	0.779	4.775	3.720	64.299	56.338	
12(3, 9) - 12(2,11)E		240756.209(9.685)	0.221	4.775	1.055	64.368	56.338	

Table 6. Microwave transitions of $^{12}CH_3{}^{12}CH^{16}O$ in order of frequency

Frequency (MHz)	Unc.	$J'\ K'_-\ K'_+\ -\ J''\ K''_-\ K''_+\ S$
939.527	(0.537)	12(3, 9) - 12(3,10)A
1065.001	(0.089)	1(1, 0) - 1(1, 1)A
1252.207	(0.278)	6(2, 4) - 6(2, 5)A
1853.399	(1.433)	1(1, 0) - 1(1, 1)E
2074.310	(2.785)	12(3, 9) - 12(3,10)E
2243.201	(0.448)	7(2, 5) - 7(2, 6)A
2597.077	(1.866)	6(2, 4) - 6(2, 5)E
3176.668	(1.334)	7(2, 5) - 7(2, 6)E
3194.939	(0.256)	2(1, 1) - 2(1, 2)A
3211.490	(1.510)	9(1, 9) - 8(2, 6)A
3527.106	(0.698)	2(1, 1) - 2(1, 2)E
3712.588	(0.655)	8(2, 6) - 8(2, 7)A
4065.535	(1.437)	9(1, 9) - 8(2, 6)E
4328.554	(0.959)	8(2, 6) - 8(2, 7)E
5666.069	(1.763)	7(2, 6) - 8(1, 8)E
5777.759	(0.889)	9(2, 7) - 9(2, 8)A
6186.582	(0.948)	9(2, 7) - 9(2, 8)E
6389.492	(0.481)	3(1, 2) - 3(1, 3)A
6546.454	(0.519)	3(1, 2) - 3(1, 3)E
6848.986	(1.725)	7(1, 6) - 6(2, 4)E
6932.783	(2.695)	11(3, 9) - 12(2,11)E
7388.166	(1.096)	1(1, 1) - 2(0, 2)E
7659.508	(1.533)	7(1, 6) - 6(2, 5)A
7881.193	(2.595)	12(2,10) - 11(3, 9)A
7936.861	(2.803)	12(2,10) - 11(3, 8)E
8245.207	(0.687)	1(1, 1) - 2(0, 2)A
8394.088	(1.637)	9(1, 9) - 8(2, 7)E
8556.043	(1.155)	10(2, 8) - 10(2, 9)A
8838.983	(1.169)	10(2, 8) - 10(2, 9)E
8842.736	(1.390)	7(2, 5) - 8(1, 8)E
8909.529	(2.341)	11(3, 8) - 12(2,11)E
9110.375	(0.643)	3(0, 3) - 2(1, 1)E
9241.566	(0.783)	1(1, 0) - 2(0, 2)E
9367.730	(2.151)	11(3, 8) - 12(2,11)A
9446.063	(1.723)	7(1, 6) - 6(2, 5)E
9541.284	(1.510)	7(2, 5) - 8(1, 8)A
9913.607	(2.944)	12(2,10) - 11(3, 9)E
10647.701	(0.734)	4(1, 3) - 4(1, 4)A
10721.359	(0.733)	4(1, 3) - 4(1, 4)E
12013.447	(0.726)	3(0, 3) - 2(1, 2)A
12158.260	(1.512)	11(2, 9) - 11(2,10)A
12366.322	(1.509)	11(2, 9) - 11(2,10)E
12495.404	(2.169)	10(3, 8) - 11(2, 9)E
12637.481	(0.840)	3(0, 3) - 2(1, 2)E
13142.547	(1.818)	5(2, 4) - 6(1, 5)E
14457.415	(2.436)	10(3, 7) - 11(2, 9)E
14688.737	(1.949)	10(3, 8) - 11(2, 9)A
14770.506	(1.541)	10(1,10) - 9(2, 7)A
15166.872	(1.554)	5(2, 4) - 6(1, 5)A
15525.986	(1.865)	5(2, 3) - 6(1, 5)E
15723.049	(1.543)	10(1,10) - 9(2, 7)E
15967.402	(0.982)	5(1, 4) - 5(1, 5)A
15989.459	(1.011)	5(1, 4) - 5(1, 5)E
16682.601	(2.110)	12(2,10) - 12(2,11)A
16846.391	(2.065)	12(2,10) - 12(2,11)E
19262.090	(0.327)	1(0, 1) - 0(0, 0)E
19265.263	(0.329)	1(0, 1) - 0(0, 0)A
20273.720	(1.937)	6(2, 5) - 7(1, 7)E
21909.631	(1.711)	10(1,10) - 9(2, 8)E
22327.138	(1.264)	6(1, 5) - 6(1, 6)E
22344.463	(1.202)	6(1, 5) - 6(1, 6)A
22870.797	(1.440)	6(2, 4) - 7(1, 7)E
23364.552	(1.514)	6(2, 4) - 7(1, 7)A
24861.726	(2.207)	10(3, 8) - 11(2,10)E
25014.625	(1.831)	11(1,11) - 10(2, 8)A
26023.674	(1.853)	11(1,11) - 10(2, 8)E
26691.892	(0.754)	4(0, 4) - 3(1, 2)E
26823.738	(2.179)	10(3, 7) - 11(2,10)E
27171.758	(1.704)	10(3, 7) - 11(2,10)A
29310.182	(1.795)	8(1, 7) - 7(2, 5)E
29719.783	(1.494)	7(1, 6) - 7(1, 7)E
29771.853	(1.410)	7(1, 6) - 7(1, 7)A
30940.456	(1.726)	8(1, 7) - 7(2, 6)A
32486.850	(1.867)	8(1, 7) - 7(2, 6)E
32707.873	(0.846)	4(0, 4) - 3(1, 3)A
33238.346	(0.856)	4(0, 4) - 3(1, 3)E
33831.791	(2.799)	12(1,12) - 11(2, 9)A
34275.349	(2.534)	9(3, 7) - 10(2, 8)E
34862.657	(2.175)	11(1,11) - 10(2, 9)E
34870.980	(2.765)	12(1,12) - 11(2, 9)E
35307.707	(2.004)	4(2, 3) - 5(1, 4)E
35469.685	(2.073)	5(2, 4) - 6(1, 6)E
35834.220	(1.205)	2(1, 2) - 1(1, 0)E
36254.978	(2.967)	9(3, 6) - 10(2, 8)E
36611.802	(2.470)	9(3, 7) - 10(2, 8)A
36647.146	(0.917)	6(1, 6) - 6(0, 6)E
37464.405	(0.559)	2(1, 2) - 1(1, 1)A
37519.330	(1.658)	4(2, 3) - 5(1, 4)A
37642.587	(2.001)	4(2, 2) - 5(1, 4)E
37687.620	(0.664)	2(1, 2) - 1(1, 1)E
37853.124	(1.580)	5(2, 3) - 6(1, 6)E
38139.363	(1.551)	5(2, 3) - 6(1, 6)A
38152.918	(1.795)	8(1, 7) - 8(1, 8)E
38238.539	(1.716)	8(1, 7) - 8(1, 8)A
38505.919	(0.622)	2(0, 2) - 1(0, 1)E
38512.334	(0.625)	2(0, 2) - 1(0, 1)A
39333.018	(0.851)	5(1, 5) - 5(0, 5)E
39361.326	(0.733)	2(1, 1) - 1(1, 0)E
39594.343	(0.604)	2(1, 1) - 1(1, 0)A
41214.726	(1.195)	2(1, 1) - 1(1, 1)E
41685.396	(0.836)	4(1, 4) - 4(0, 4)E
43114.332	(2.424)	9(3, 7) - 10(2, 9)E
43540.177	(0.922)	5(0, 5) - 4(1, 3)E
43627.756	(0.884)	3(1, 3) - 3(0, 3)E
45075.786	(1.020)	2(1, 2) - 2(0, 2)E
45093.961	(2.704)	9(3, 6) - 10(2, 9)E
45343.185	(2.143)	9(3, 6) - 10(2, 9)A
45894.086	(1.303)	1(1, 1) - 1(0, 1)E
47237.302	(3.168)	12(1,12) - 11(2,10)E
47608.493	(2.385)	9(1, 8) - 9(1, 9)E
47728.240	(2.350)	9(1, 8) - 9(1, 9)A
47747.485	(1.021)	1(1, 0) - 1(0, 1)E
47822.542	(0.985)	1(1, 0) - 1(0, 1)A
48602.892	(0.889)	2(1, 1) - 2(0, 2)E
48904.551	(0.974)	2(1, 1) - 2(0, 2)A
50174.210	(0.882)	3(1, 2) - 3(0, 3)E
50561.081	(0.968)	3(1, 2) - 3(0, 3)A
51297.166	(2.176)	4(2, 3) - 5(1, 5)E
51674.027	(2.410)	9(1, 8) - 8(2, 6)E
52406.755	(0.914)	4(1, 3) - 4(0, 4)E
52738.132	(0.913)	3(1, 3) - 2(1, 1)E
52831.879	(0.975)	4(1, 3) - 4(0, 4)A
53632.046	(1.769)	4(2, 2) - 5(1, 5)E
53756.373	(1.646)	4(2, 2) - 5(1, 5)A
53779.913	(0.962)	5(0, 5) - 4(1, 4)A
54261.536	(0.953)	5(0, 5) - 4(1, 4)E
54652.318	(2.316)	9(1, 8) - 8(2, 7)A
55322.477	(0.968)	5(1, 4) - 5(0, 5)E
55469.919	(3.257)	8(3, 6) - 9(2, 7)E
55768.838	(0.998)	5(1, 4) - 5(0, 5)A
56002.581	(2.427)	9(1, 8) - 8(2, 7)E
56185.037	(0.770)	3(1, 3) - 2(1, 2)A
56265.238	(0.790)	3(1, 3) - 2(1, 2)E
57043.568	(2.239)	3(2, 2) - 4(1, 3)E

Table 6. Microwave transitions of $^{12}CH_3{}^{12}CH^{16}O$ in order of frequency—Continued

Frequency (MHz)	Unc.	J' K'₋ K'₊ - J" K"₋ K"₊ S	Frequency (MHz)	Unc.	J' K'₋ K'₊ - J" K"₋ K"₊ S
57476.284	(3.627)	8(3, 5) - 9(2, 7)E	82329.774	(2.735)	10(1, 9) - 10(0,10)E
57713.267	(0.855)	3(0, 3) - 2(0, 2)E	82490.421	(4.206)	7(3, 4) - 8(2, 7)E
57723.059	(0.859)	3(0, 3) - 2(0, 2)A	82515.045	(3.584)	7(3, 4) - 8(2, 7)A
57789.918	(0.610)	3(2, 2) - 2(2, 1)A	82821.968	(2.714)	10(1, 9) - 10(0,10)A
57819.355	(0.623)	3(2, 1) - 2(2, 0)E	83581.705	(1.482)	2(1, 2) - 1(0, 1)E
57829.046	(0.616)	3(2, 2) - 2(2, 1)E	84221.946	(1.411)	2(1, 2) - 1(0, 1)A
57861.883	(0.615)	3(2, 1) - 2(2, 0)A	84859.623	(2.388)	2(2, 1) - 3(1, 3)E
57945.826	(3.220)	8(3, 6) - 9(2, 7)A	85645.101	(1.185)	4(1, 3) - 3(1, 3)E
58062.599	(3.521)	10(1, 9) - 10(1,10)E	87108.811	(1.408)	2(1, 1) - 1(0, 1)E
58218.077	(3.550)	10(1, 9) - 10(1,10)A	87149.946	(1.999)	2(2, 0) - 3(1, 3)A
58974.285	(1.042)	6(1, 5) - 6(0, 6)E	87205.947	(2.256)	2(2, 0) - 3(1, 3)E
59284.585	(0.858)	3(1, 2) - 2(1, 1)E	90684.293	(4.284)	11(1,10) - 11(0,11)E
59379.590	(0.820)	3(1, 2) - 2(1, 1)A	91184.149	(4.299)	11(1,10) - 11(0,11)A
59380.201	(2.115)	3(2, 1) - 4(1, 3)E	93581.349	(0.953)	5(1, 5) - 4(1, 4)A
59382.112	(1.804)	3(2, 2) - 4(1, 3)A	93594.554	(0.952)	5(1, 5) - 4(1, 4)E
59434.455	(1.039)	6(1, 5) - 6(0, 6)A	94091.216	(2.592)	5(2, 4) - 4(2, 2)E
59616.971	(1.098)	6(0, 6) - 5(1, 4)E	94408.907	(10.493)	11(4, 8) - 12(3, 9)E
61656.501	(2.999)	8(3, 6) - 9(2, 8)E	95233.847	(9.979)	11(4, 7) - 12(3, 9)E
62811.691	(1.015)	3(1, 2) - 2(1, 2)E	95507.358	(5.191)	11(1,10) - 10(2, 8)E
63429.001	(1.148)	7(1, 6) - 7(0, 7)E	95946.932	(1.050)	5(0, 5) - 4(0, 4)E
63662.865	(3.449)	8(3, 5) - 9(2, 8)E	95964.091	(1.057)	5(0, 5) - 4(0, 4)A
63811.428	(2.873)	8(3, 5) - 9(2, 8)A	96263.885	(10.189)	11(4, 8) - 12(3, 9)A
63899.238	(1.114)	7(1, 6) - 7(0, 7)A	96273.805	(0.766)	5(2, 4) - 4(2, 3)A
65156.176	(1.506)	1(1, 1) - 0(0, 0)E	96310.530	(4.615)	6(3, 4) - 7(2, 5)E
66022.804	(1.218)	1(1, 1) - 0(0, 0)A	96342.402	(1.976)	5(4, 2) - 4(4, 1)A
67009.575	(1.256)	1(1, 0) - 0(0, 0)E	96342.415	(1.976)	5(4, 1) - 4(4, 0)A
67764.927	(2.280)	3(2, 2) - 4(1, 4)E	96353.741	(1.966)	5(4, 1) - 4(4, 0)E
68377.288	(1.000)	4(1, 4) - 3(1, 2)E	96360.862	(1.966)	5(4, 2) - 4(4, 1)E
68759.519	(1.354)	8(1, 7) - 8(0, 8)E	96366.817	(1.044)	5(3, 3) - 4(3, 2)A
69237.789	(1.299)	8(1, 7) - 8(0, 8)A	96368.222	(1.049)	5(3, 2) - 4(3, 1)E
69483.684	(5.379)	11(1,10) - 11(1,11)E	96370.821	(1.044)	5(3, 2) - 4(3, 1)A
69677.167	(5.473)	11(1,10) - 11(1,11)A	96384.948	(1.047)	5(3, 3) - 4(3, 2)E
70101.560	(1.994)	3(2, 1) - 4(1, 4)E	96426.096	(0.776)	5(2, 4) - 4(2, 3)E
70119.778	(1.800)	3(2, 1) - 4(1, 4)A	96474.655	(0.804)	5(2, 3) - 4(2, 2)E
73785.648	(3.582)	10(1, 9) - 9(2, 7)E	96483.217	(10.034)	11(4, 8) - 12(3,10)E
74790.161	(2.804)	4(2, 3) - 3(2, 1)E	96632.192	(0.773)	5(2, 3) - 4(2, 2)A
74855.208	(1.289)	7(0, 7) - 6(1, 5)E	96764.946	(1.177)	7(0, 7) - 6(1, 6)A
74892.050	(0.904)	4(1, 4) - 3(1, 3)A	97182.347	(1.181)	7(0, 7) - 6(1, 6)E
74923.742	(0.906)	4(1, 4) - 3(1, 3)E	97214.216	(9.949)	11(4, 7) - 12(3,10)A
75038.180	(1.816)	9(1, 8) - 9(0, 9)E	97308.157	(10.607)	11(4, 7) - 12(3,10)E
75159.211	(1.050)	6(0, 6) - 5(1, 5)A	98367.696	(4.599)	6(3, 3) - 7(2, 5)E
75523.482	(1.766)	9(1, 8) - 9(0, 9)A	98809.534	(2.510)	5(2, 3) - 4(2, 3)E
75606.430	(1.045)	6(0, 6) - 5(1, 5)E	98862.654	(0.976)	5(1, 4) - 4(1, 3)E
76128.672	(3.967)	7(3, 5) - 8(2, 6)E	98901.049	(0.972)	5(1, 4) - 4(1, 3)A
76866.102	(1.001)	4(0, 4) - 3(0, 3)E	99141.854	(4.413)	6(3, 4) - 7(2, 5)A
76879.462	(1.006)	4(0, 4) - 3(0, 3)A	99487.198	(4.195)	6(3, 4) - 7(2, 6)E
77038.268	(0.706)	4(2, 3) - 3(2, 2)A	100130.239	(6.614)	12(1,11) - 12(0,12)E
77082.202	(0.779)	4(3, 2) - 3(3, 1)A	100639.550	(6.669)	12(1,11) - 12(0,12)A
77082.357	(0.782)	4(3, 1) - 3(3, 0)E	101246.012	(5.449)	12(2,11) - 12(1,11)E
77083.347	(0.779)	4(3, 1) - 3(3, 0)A	101341.024	(1.547)	3(1, 3) - 2(0, 2)E
77095.549	(0.782)	4(3, 2) - 3(3, 1)E	101401.064	(4.201)	6(3, 3) - 7(2, 6)A
77125.041	(0.730)	4(2, 2) - 3(2, 1)E	101544.363	(4.915)	6(3, 3) - 7(2, 6)E
77126.793	(0.715)	4(2, 3) - 3(2, 2)E	101894.649	(1.544)	3(1, 3) - 2(0, 2)A
77217.944	(0.715)	4(2, 2) - 3(2, 1)A	103247.835	(5.031)	11(1,10) - 10(2, 9)A
78161.867	(4.176)	7(3, 4) - 8(2, 6)E	104346.341	(5.061)	11(1,10) - 10(2, 9)E
78313.169	(2.526)	2(2, 1) - 3(1, 2)E	106926.279	(4.760)	11(2,10) - 11(1,10)E
78762.473	(3.878)	7(3, 5) - 8(2, 6)A	107887.477	(1.598)	3(1, 2) - 2(0, 2)E
78766.343	(3.407)	10(1, 9) - 9(2, 8)A	112234.212	(3.632)	10(2, 9) - 10(1, 9)E
79098.647	(0.955)	4(1, 3) - 3(1, 2)E	112249.203	(0.946)	6(1, 6) - 5(1, 5)A
79150.260	(0.944)	4(1, 3) - 3(1, 2)A	112253.577	(0.945)	6(1, 6) - 5(1, 5)E
79461.673	(2.721)	4(2, 2) - 3(2, 2)E	113312.161	(2.289)	6(2, 5) - 5(2, 3)E
79972.230	(3.480)	10(1, 9) - 9(2, 8)E	114084.390	(11.654)	10(4, 7) - 11(3, 8)E
80457.225	(3.627)	7(3, 5) - 8(2, 7)E	114927.825	(11.111)	10(4, 6) - 11(3, 8)E
80659.493	(2.230)	2(2, 0) - 3(1, 2)E	114939.448	(1.029)	6(0, 6) - 5(0, 5)E
80742.454	(1.990)	2(2, 1) - 3(1, 2)A	114960.646	(1.037)	6(0, 6) - 5(0, 5)A
81830.996	(8.081)	12(1,11) - 12(1,12)E	115493.342	(0.896)	6(2, 5) - 5(2, 4)A
82065.241	(8.233)	12(1,11) - 12(1,12)A	115605.658	(4.293)	6(5, 2) - 5(5, 1)A

Table 6. Microwave transitions of $^{12}CH_3{}^{12}CH^{16}O$ in order of frequency—Continued

Frequency (MHz)	Unc.	J' K'_ K'+ - J" K"_ K"+ S	Frequency (MHz)	Unc.	J' K'_ K'+ - J" K"_ K"+ S
115605.658	(4.293)	6(5, 1) - 5(5, 0)A	134876.425	(7.832)	7(6, 1) - 6(6, 0)E
115620.900	(4.281)	6(5, 1) - 5(5, 0)E	134881.491	(5.440)	7(5, 3) - 6(5, 2)A
115621.798	(2.646)	6(4, 3) - 5(4, 2)A	134881.491	(5.440)	7(5, 2) - 6(5, 1)A
115621.859	(2.646)	6(4, 2) - 5(4, 1)A	134896.025	(1.297)	7(2, 6) - 6(2, 5)E
115627.323	(4.282)	6(5, 2) - 5(5, 1)E	134897.925	(7.828)	7(6, 2) - 6(6, 1)E
115635.386	(2.634)	6(4, 2) - 5(4, 1)E	134899.454	(5.426)	7(5, 2) - 6(5, 1)E
115644.117	(2.634)	6(4, 3) - 5(4, 2)E	134906.775	(5.427)	7(5, 3) - 6(5, 2)E
115659.780	(1.453)	6(3, 4) - 5(3, 3)A	134907.116	(3.508)	7(4, 4) - 6(4, 3)A
115664.305	(1.458)	6(3, 3) - 5(3, 2)E	134907.318	(3.508)	7(4, 3) - 6(4, 2)A
115670.449	(1.453)	6(3, 3) - 5(3, 2)A	134922.972	(3.495)	7(4, 3) - 6(4, 2)E
115684.678	(1.454)	6(3, 4) - 5(3, 3)E	134933.413	(3.495)	7(4, 4) - 6(4, 3)E
115695.600	(0.914)	6(2, 5) - 5(2, 4)E	134961.760	(2.076)	7(3, 5) - 6(3, 4)A
115909.239	(0.944)	6(2, 4) - 5(2, 3)E	134972.773	(2.080)	7(3, 4) - 6(3, 3)E
116061.136	(11.239)	10(4, 7) - 11(3, 9)E	134985.735	(2.073)	7(3, 4) - 6(3, 3)A
116101.467	(5.199)	5(3, 3) - 6(2, 4)E	134996.743	(2.073)	7(3, 5) - 6(3, 4)E
116103.372	(11.367)	10(4, 7) - 11(3, 8)A	135279.950	(1.574)	5(1, 5) - 4(0, 4)E
116117.521	(0.887)	6(2, 4) - 5(2, 3)A	135475.616	(1.287)	7(2, 5) - 6(2, 4)E
116674.742	(11.197)	10(4, 6) - 11(3, 9)A	135598.871	(12.275)	9(4, 6) - 10(3, 8)E
116701.976	(7.166)	12(1,11) - 11(2, 9)E	135625.758	(5.699)	4(3, 2) - 5(2, 3)E
116904.570	(11.874)	10(4, 6) - 11(3, 9)E	135684.701	(1.230)	7(2, 5) - 6(2, 4)A
117121.063	(2.943)	9(2, 8) - 9(1, 8)E	135765.526	(1.596)	5(1, 5) - 4(0, 4)A
118092.403	(5.291)	12(2,10) - 12(1,11)E	135791.424	(12.388)	9(4, 6) - 10(3, 7)A
118179.006	(4.949)	5(3, 2) - 6(2, 4)E	136118.351	(12.277)	9(4, 5) - 10(3, 8)A
118292.677	(2.229)	6(2, 4) - 5(2, 4)E	136142.215	(2.694)	3(2, 2) - 3(1, 2)E
118508.718	(1.507)	8(0, 8) - 7(1, 7)A	136458.600	(12.952)	9(4, 5) - 10(3, 8)E
118551.498	(1.587)	4(1, 4) - 3(0, 3)E	136505.242	(2.219)	4(2, 2) - 4(1, 3)E
118591.256	(0.966)	6(1, 5) - 5(1, 4)E	136690.020	(2.012)	4(2, 2) - 4(1, 3)A
118626.264	(0.966)	6(1, 5) - 5(1, 4)A	137597.754	(3.038)	2(2, 1) - 2(1, 1)E
118698.545	(4.675)	5(3, 3) - 6(2, 5)E	137720.023	(5.265)	4(3, 1) - 5(2, 3)E
118897.076	(1.520)	8(0, 8) - 7(1, 7)E	138009.197	(5.066)	4(3, 2) - 5(2, 4)E
118927.184	(5.434)	12(2,10) - 12(1,11)A	138072.693	(1.998)	7(2, 5) - 6(2, 5)E
119063.640	(1.603)	4(1, 4) - 3(0, 3)A	138284.210	(1.125)	7(1, 6) - 6(1, 5)E
119166.774	(4.848)	5(3, 3) - 6(2, 4)A	138319.722	(1.125)	7(1, 6) - 6(1, 5)A
119292.601	(4.379)	11(2, 9) - 11(1,10)E	138478.848	(2.385)	3(2, 1) - 3(1, 2)E
120151.763	(4.524)	11(2, 9) - 11(1,10)A	138622.337	(2.219)	3(2, 1) - 3(1, 2)A
120424.321	(4.716)	5(3, 2) - 6(2, 5)A	138917.479	(5.209)	4(3, 2) - 5(2, 3)A
120776.084	(5.531)	5(3, 2) - 6(2, 5)E	139546.842	(5.137)	4(3, 1) - 5(2, 4)A
121073.195	(3.527)	10(2, 8) - 10(1, 9)E	139944.079	(2.515)	2(2, 0) - 2(1, 1)E
121539.866	(2.401)	8(2, 7) - 8(1, 7)E	140103.462	(6.016)	4(3, 1) - 5(2, 4)E
121938.265	(3.672)	10(2, 8) - 10(1, 9)A	140140.044	(2.410)	2(2, 0) - 2(1, 1)A
123307.645	(2.788)	9(2, 7) - 9(1, 8)E	140298.674	(2.184)	9(0, 9) - 8(1, 8)A
124149.828	(2.924)	9(2, 7) - 9(1, 8)A	140657.185	(2.203)	9(0, 9) - 8(1, 8)E
125449.962	(2.063)	7(2, 6) - 7(1, 6)E	141124.860	(2.648)	2(2, 1) - 2(1, 2)E
125868.419	(2.232)	8(2, 6) - 8(1, 7)E	142688.669	(2.588)	3(2, 2) - 3(1, 3)E
126643.887	(2.330)	8(2, 6) - 8(1, 7)A	143316.982	(2.434)	2(2, 1) - 2(1, 2)A
128055.291	(7.215)	12(1,11) - 11(2,10)A	143471.185	(2.713)	2(2, 0) - 2(1, 2)E
128626.630	(1.943)	7(2, 5) - 7(1, 6)E	144891.720	(2.452)	4(2, 3) - 4(1, 4)E
128838.147	(1.990)	6(2, 5) - 6(1, 5)E	144921.863	(2.256)	3(2, 2) - 3(1, 3)A
129068.298	(7.205)	12(1,11) - 11(2,10)E	145025.302	(2.431)	3(2, 1) - 3(1, 3)E
129272.857	(1.706)	4(1, 3) - 3(0, 3)E	147068.081	(2.054)	4(2, 3) - 4(1, 4)A
129277.400	(1.944)	7(2, 5) - 7(1, 6)A	147226.600	(2.156)	4(2, 2) - 4(1, 4)E
130891.566	(1.000)	7(1, 7) - 6(1, 6)E	147723.262	(2.292)	5(2, 4) - 5(1, 5)E
130892.332	(1.000)	7(1, 7) - 6(1, 6)A	149503.676	(1.327)	8(1, 8) - 7(1, 7)E
131435.224	(1.926)	6(2, 4) - 6(1, 5)E	149507.969	(1.325)	8(1, 8) - 7(1, 7)A
131733.803	(2.135)	5(2, 4) - 5(1, 4)E	149760.537	(1.876)	5(2, 4) - 5(1, 5)A
131912.421	(1.793)	6(2, 4) - 6(1, 5)A	150106.701	(1.906)	5(2, 3) - 5(1, 5)E
132298.948	(2.041)	7(2, 6) - 6(2, 4)E	150850.048	(2.293)	8(2, 7) - 7(2, 5)E
133636.860	(12.685)	9(4, 6) - 10(3, 7)E	151165.285	(2.161)	6(2, 5) - 6(1, 6)E
133829.493	(1.057)	7(0, 7) - 6(0, 6)E	151269.409	(1.710)	5(1, 4) - 4(0, 4)E
133854.938	(1.063)	7(0, 7) - 6(0, 6)A	151586.595	(1.542)	6(1, 6) - 5(0, 5)E
134117.242	(2.052)	5(2, 3) - 5(1, 4)E	152050.638	(1.567)	6(1, 6) - 5(0, 5)A
134170.362	(2.391)	4(2, 3) - 4(1, 3)E	152606.294	(1.360)	8(0, 8) - 7(0, 7)E
134421.163	(1.843)	5(2, 3) - 5(1, 4)A	152636.103	(1.362)	8(0, 8) - 7(0, 7)A
134496.589	(12.114)	9(4, 5) - 10(3, 7)E	153004.677	(1.816)	6(2, 5) - 6(1, 6)A
134693.706	(1.264)	7(2, 6) - 6(2, 5)A	153105.098	(13.583)	8(4, 5) - 9(3, 6)E
134874.660	(7.836)	7(6, 2) - 6(6, 1)A	153762.363	(1.773)	6(2, 4) - 6(1, 6)E
134874.660	(7.836)	7(6, 1) - 6(6, 0)A	153871.755	(1.959)	8(2, 7) - 7(2, 6)A

Table 6. Microwave transitions of $^{12}CH_3{}^{12}CH^{16}O$ in order of frequency—Continued

Frequency (MHz)	Unc.	J' K'₋ K'₊ - J" K"₋ K"₊ S	Frequency (MHz)	Unc.	J' K'₋ K'₊ - J" K"₋ K"₊ S
153979.041	(12.979)	8(4, 4) - 9(3, 6)E	173424.893	(11.519)	9(6, 4) - 8(6, 3)A
154026.716	(1.993)	8(2, 7) - 7(2, 6)E	173424.893	(11.519)	9(6, 3) - 8(6, 2)A
154131.590	(12.809)	8(7, 1) - 7(7, 0)E	173427.717	(11.515)	9(6, 3) - 8(6, 2)E
154148.559	(9.547)	8(6, 3) - 7(6, 2)A	173435.538	(15.166)	9(7, 3) - 8(7, 2)E
154148.559	(9.547)	8(6, 2) - 7(6, 1)A	173445.082	(8.457)	9(5, 5) - 8(5, 4)A
154148.727	(12.803)	8(7, 2) - 7(7, 1)A	173445.092	(8.457)	9(5, 4) - 8(5, 3)A
154148.727	(12.803)	8(7, 1) - 7(7, 0)A	173455.030	(11.509)	9(6, 4) - 8(6, 3)E
154150.809	(9.542)	8(6, 2) - 7(6, 1)E	173468.734	(8.441)	5(5, 4) - 8(5, 3)E
154161.011	(12.798)	8(7, 2) - 7(7, 1)E	173477.600	(8.441)	5(5, 5) - 8(5, 4)E
154161.118	(6.813)	8(5, 4) - 7(5, 3)A	173499.243	(5.993)	5(4, 6) - 8(4, 5)A
154161.121	(6.813)	8(5, 3) - 7(5, 2)A	173500.575	(5.993)	9(4, 5) - 8(4, 4)A
154175.244	(9.538)	8(6, 3) - 7(6, 2)E	173519.944	(5.980)	9(4, 5) - 8(4, 4)E
154181.882	(6.799)	8(5, 3) - 7(5, 2)E	173534.158	(5.978)	9(4, 6) - 8(4, 5)E
154190.021	(6.799)	8(5, 4) - 7(5, 3)E	173592.824	(4.159)	9(3, 7) - 8(3, 6)A
154199.297	(4.609)	8(4, 5) - 7(4, 4)A	173637.537	(4.158)	9(3, 6) - 8(3, 5)E
154199.853	(4.609)	8(4, 4) - 7(4, 3)A	173664.272	(4.149)	9(3, 7) - 8(3, 6)E
154217.492	(4.596)	8(4, 4) - 7(4, 3)E	173680.322	(4.145)	9(3, 6) - 8(3, 5)A
154229.756	(4.594)	8(4, 5) - 7(4, 4)E	173913.733	(1.654)	6(1, 5) - 5(0, 5)E
154272.911	(2.964)	8(3, 6) - 7(3, 5)A	174519.244	(13.877)	7(4, 4) - 8(3, 6)E
154296.089	(2.967)	8(3, 5) - 7(3, 4)E	174843.117	(13.988)	7(4, 4) - 8(3, 5)A
154320.769	(2.957)	8(3, 5) - 7(3, 4)A	174931.237	(13.952)	7(4, 3) - 8(3, 6)A
154322.920	(2.958)	8(3, 6) - 7(3, 5)E	174981.672	(2.982)	9(2, 7) - 8(2, 6)E
155004.863	(6.106)	3(3, 1) - 4(2, 2)E	175089.558	(2.976)	9(2, 7) - 8(2, 6)A
155084.727	(13.149)	8(4, 5) - 9(3, 7)E	176409.963	(6.514)	11(2,10) - 11(1,11)E
155169.745	(2.195)	7(2, 6) - 7(1, 7)E	176959.081	(3.648)	2(2, 1) - 1(1, 0)E
155178.601	(1.943)	8(2, 6) - 7(2, 5)E	177542.447	(2.684)	9(1, 8) - 8(1, 7)E
155341.141	(1.917)	8(2, 6) - 7(2, 5)A	177583.616	(2.683)	9(1, 8) - 8(1, 7)A
155362.093	(13.257)	8(4, 5) - 9(3, 6)A	177670.670	(6.542)	11(2,10) - 11(1,11)A
155538.266	(13.191)	8(4, 4) - 9(3, 7)A	178812.480	(2.860)	2(2, 1) - 1(1, 1)E
155958.670	(13.859)	8(4, 4) - 9(3, 7)E	179135.794	(4.578)	10(2, 8) - 10(1,10)E
156806.052	(2.004)	7(2, 6) - 7(1, 7)A	179305.405	(2.850)	2(2, 0) - 1(1, 0)E
157112.321	(5.547)	3(3, 0) - 4(2, 2)E	179310.226	(3.006)	9(2, 7) - 8(2, 7)E
157339.743	(5.378)	3(3, 1) - 4(2, 3)E	179716.386	(2.825)	2(2, 1) - 1(1, 0)A
157936.812	(1.684)	8(1, 7) - 7(1, 6)E	180799.388	(2.837)	2(2, 0) - 1(1, 1)A
157974.654	(1.683)	8(1, 7) - 7(1, 6)A	181158.804	(3.228)	2(2, 0) - 1(1, 1)E
158346.413	(1.922)	7(2, 5) - 7(1, 7)E	183077.008	(8.813)	12(2,11) - 12(1,12)E
158355.269	(2.179)	8(2, 6) - 7(2, 6)E	183212.895	(1.907)	8(1, 8) - 7(0, 7)E
158467.469	(5.508)	3(3, 1) - 4(2, 2)A	183635.354	(1.947)	8(1, 8) - 7(0, 7)A
158737.301	(5.476)	3(3, 0) - 4(2, 3)A	183663.985	(4.704)	11(0,11) - 10(1,10)A
159447.200	(6.381)	3(3, 0) - 4(2, 3)E	183958.859	(4.728)	11(0,11) - 10(1,10)E
159692.784	(2.600)	8(2, 7) - 8(1, 8)E	184309.823	(8.845)	12(2,11) - 12(1,12)A
161169.838	(2.540)	8(2, 7) - 8(1, 8)A	186019.860	(4.670)	10(2, 9) - 9(2, 7)E
162044.684	(3.251)	10(0,10) - 9(1, 9)A	186200.646	(3.565)	2(2, 1) - 2(0, 2)E
162372.012	(3.273)	10(0,10) - 9(1, 9)E	186316.425	(3.317)	3(2, 2) - 3(0, 3)E
164021.338	(2.440)	8(2, 6) - 8(1, 8)E	186577.116	(3.034)	4(2, 3) - 4(0, 4)E
164729.556	(3.455)	9(2, 8) - 9(1, 9)E	186639.187	(3.115)	10(1,10) - 9(1, 9)E
166100.309	(3.455)	9(2, 8) - 9(1, 9)A	186648.575	(3.110)	10(1,10) - 9(1, 9)A
167538.712	(1.597)	7(1, 7) - 6(0, 6)E	187056.280	(2.766)	5(2, 4) - 5(0, 5)E
167982.323	(1.628)	7(1, 7) - 6(0, 6)A	187812.432	(2.601)	6(2, 5) - 6(0, 6)E
168086.873	(2.036)	9(1, 9) - 8(1, 8)E	188546.971	(3.284)	2(2, 0) - 2(0, 2)E
168093.915	(2.033)	9(1, 9) - 8(1, 8)A	188653.058	(3.033)	3(2, 1) - 3(0, 3)E
168795.091	(3.243)	9(2, 8) - 8(2, 6)E	188776.285	(6.421)	11(2, 9) - 11(1,11)E
170296.811	(4.751)	10(2, 9) - 10(1,10)E	188878.964	(2.685)	7(2, 6) - 7(0, 7)E
170916.138	(3.306)	9(2, 7) - 9(1, 9)E	188911.996	(2.740)	4(2, 2) - 4(0, 4)E
171263.786	(2.066)	9(0, 9) - 8(0, 8)E	189026.594	(3.278)	2(2, 1) - 2(0, 2)A
171297.924	(2.064)	9(0, 9) - 8(8, 8)A	189093.453	(3.031)	3(2, 2) - 3(0, 3)A
171600.299	(4.772)	10(2, 9) - 10(1,10)A	189252.258	(2.753)	4(2, 3) - 4(0, 4)A
173024.386	(2.997)	9(2, 8) - 8(2, 7)A	189439.719	(2.462)	5(2, 3) - 5(0, 5)E
173123.644	(3.021)	9(2, 8) - 8(2, 7)E	189561.973	(2.511)	5(2, 4) - 5(0, 5)A
173391.504	(19.418)	9(8, 1) - 8(8, 0)E	189801.699	(3.156)	10(0,10) - 9(0, 9)E
173399.086	(13.710)	7(4, 3) - 8(3, 5)E	189839.925	(3.152)	10(0,10) - 9(0, 9)A
173402.479	(15.178)	9(7, 2) - 8(7, 1)E	189960.634	(28.553)	11(5, 7) - 12(4, 8)E
173415.064	(19.406)	9(8, 2) - 8(8, 1)E	190094.669	(2.420)	6(2, 5) - 6(0, 6)A
173421.501	(15.171)	9(7, 3) - 8(7, 2)A	190299.385	(3.154)	8(2, 7) - 8(0, 8)E
173421.501	(15.171)	9(7, 2) - 8(7, 1)A	190409.509	(2.310)	6(2, 4) - 6(0, 6)E
173423.543	(19.406)	9(8, 1) - 8(8, 0)A	190785.985	(28.886)	11(5, 7) - 12(4, 8)A
173423.543	(19.406)	9(8, 2) - 8(8, 1)A	190807.662	(28.866)	11(5, 6) - 12(4, 9)A

Table 6. Microwave transitions of $^{12}CH_3{}^{12}CH^{16}O$ in order of frequency—Continued

Frequency (MHz)	Unc.	$J'\ K'_-\ K'_+\ -\ J''\ K''_-\ K''_+$ S	Frequency (MHz)	Unc.	$J'\ K'_-\ K'_+\ -\ J''\ K''_-\ K''_+$ S
190933.437	(2.615)	7(2, 6) - 7(0, 7)A	205159.468	(4.551)	11(1,11) - 10(1,10)E
191040.385	(6.416)	10(3, 8) - 9(3, 6)E	205170.967	(4.546)	11(1,11) - 10(1,10)A
191409.377	(28.824)	11(5, 6) - 12(4, 9)E	205348.022	(6.566)	12(0,12) - 11(1,11)E
192055.631	(2.453)	7(2, 5) - 7(0, 7)E	208226.034	(4.606)	11(0,11) - 10(0,10)E
192148.564	(4.388)	10(2, 9) - 9(2, 8)A	208267.875	(4.601)	11(0,11) - 10(0,10)A
192159.243	(4.007)	9(2, 8) - 9(0, 9)E	209377.843	(29.827)	10(5, 6) - 11(4, 7)E
192169.088	(3.165)	8(2, 7) - 8(0, 8)A	209976.894	(6.642)	11(2, 9) - 11(0,11)E
192206.442	(4.404)	10(2, 9) - 9(2, 8)E	210222.194	(30.158)	10(5, 6) - 11(4, 7)A
192659.134	(27.873)	10(9, 1) - 9(9, 0)E	210233.038	(30.148)	10(5, 5) - 11(4, 8)A
192659.804	(22.538)	10(8, 2) - 9(8, 1)E	210423.356	(8.066)	11(3, 9) - 10(3, 7)E
192662.883	(27.871)	10(9, 2) - 9(9, 1)E	210857.313	(30.083)	10(5, 5) - 11(4, 8)E
192674.933	(17.840)	10(7, 3) - 9(7, 2)E	211241.338	(6.150)	11(2,10) - 10(2, 9)A
192686.104	(22.525)	10(8, 3) - 9(8, 2)E	211272.619	(6.163)	11(2,10) - 10(2, 9)E
192692.752	(27.863)	10(9, 1) - 9(9, 0)A	211910.667	(38.405)	11(10, 1) - 10(10, 0)E
192692.752	(27.863)	10(9, 2) - 9(9, 1)A	211925.706	(31.838)	11(9, 2) - 10(9, 1)E
192695.203	(22.525)	10(8, 3) - 9(8, 2)A	211928.917	(25.984)	11(8, 3) - 10(8, 2)E
192695.203	(22.525)	10(8, 2) - 9(8, 1)A	211930.142	(31.834)	11(9, 3) - 10(9, 2)E
192695.750	(17.833)	10(7, 4) - 9(7, 3)A	211933.030	(38.399)	11(10, 2) - 10(10, 1)E
192695.750	(17.833)	10(7, 3) - 9(7, 2)A	211949.122	(20.836)	11(7, 4) - 10(7, 3)E
192703.964	(13.793)	10(6, 5) - 9(6, 4)A	211951.077	(38.391)	11(10, 2) - 10(10, 1)A
192703.964	(13.793)	10(6, 4) - 9(6, 3)A	211951.077	(38.391)	11(10, 1) - 10(10, 0)A
192707.464	(13.788)	10(6, 4) - 9(6, 3)E	211957.989	(25.969)	11(8, 4) - 10(8, 3)E
192711.609	(17.827)	10(7, 4) - 9(7, 3)E	211962.649	(31.826)	11(9, 2) - 10(9, 1)A
192733.924	(10.413)	10(5, 6) - 9(5, 5)A	211962.649	(31.826)	11(9, 3) - 10(9, 2)A
192733.951	(10.413)	10(5, 5) - 9(5, 4)A	211967.607	(25.970)	11(8, 4) - 10(8, 3)A
192737.588	(13.781)	10(6, 5) - 9(6, 4)E	211967.607	(25.970)	11(8, 3) - 10(8, 2)A
192760.562	(10.396)	10(5, 5) - 9(5, 4)E	211971.634	(20.828)	11(7, 5) - 10(7, 4)A
192770.050	(10.396)	10(5, 6) - 9(5, 5)E	211971.634	(20.828)	11(7, 4) - 10(7, 3)A
192772.204	(14.316)	6(4, 2) - 7(3, 4)E	211986.078	(16.410)	11(6, 6) - 10(6, 5)A
192807.794	(7.704)	10(4, 7) - 9(4, 6)A	211986.079	(16.410)	11(6, 5) - 10(6, 4)A
192810.676	(7.703)	10(4, 6) - 9(4, 5)A	211989.392	(20.821)	11(7, 5) - 10(7, 4)E
192831.337	(7.690)	10(4, 6) - 9(4, 5)E	211990.363	(16.404)	11(6, 5) - 10(6, 4)E
192847.632	(7.687)	10(4, 7) - 9(4, 6)E	212023.221	(16.397)	11(6, 6) - 10(6, 5)E
192920.489	(5.697)	10(3, 8) - 9(3, 7)A	212028.185	(12.723)	11(5, 7) - 10(5, 6)A
193002.396	(5.689)	10(3, 7) - 9(3, 6)E	212028.253	(12.723)	11(5, 6) - 10(5, 5)A
193020.014	(5.684)	10(3, 8) - 9(3, 7)E	212057.918	(12.705)	11(5, 6) - 10(5, 5)E
193069.912	(5.674)	10(3, 7) - 9(3, 6)A	212067.913	(12.705)	11(5, 7) - 10(5, 6)E
193895.550	(4.053)	9(2, 8) - 9(0, 9)A	212109.591	(14.807)	5(4, 1) - 6(3, 3)E
193908.751	(14.476)	6(4, 3) - 7(3, 5)E	212125.708	(9.780)	11(4, 8) - 10(4, 7)A
194256.771	(14.593)	6(4, 3) - 7(3, 4)A	212131.463	(9.778)	11(4, 7) - 10(4, 6)A
194296.831	(14.576)	6(4, 2) - 7(3, 5)A	212152.703	(9.767)	11(4, 7) - 10(4, 6)E
194563.986	(5.203)	10(2, 9) - 10(0,10)E	212171.197	(9.762)	11(4, 8) - 10(4, 7)E
194627.939	(2.986)	8(2, 6) - 8(0, 8)E	212254.286	(7.614)	11(3, 9) - 10(3, 8)A
194858.843	(4.431)	10(2, 8) - 9(2, 7)E	212385.367	(7.602)	11(3, 9) - 10(3, 8)E
194926.848	(4.430)	10(2, 8) - 9(2, 7)A	212400.102	(7.595)	11(3, 8) - 10(3, 7)E
194982.026	(6.555)	10(3, 7) - 9(3, 7)E	212495.845	(7.581)	11(3, 8) - 10(3, 7)A
195426.800	(3.320)	3(2, 2) - 2(1, 1)E	213261.377	(14.959)	5(4, 2) - 6(3, 4)E
196204.189	(5.261)	10(2, 9) - 10(0,10)A	213269.009	(3.022)	4(2, 3) - 3(1, 2)E
197093.293	(4.099)	10(1, 9) - 9(1, 8)E	213620.708	(15.084)	5(4, 2) - 6(3, 3)A
197138.412	(4.096)	10(1, 9) - 9(1, 8)A	213636.732	(15.077)	5(4, 1) - 6(3, 4)A
197610.571	(6.754)	11(2,10) - 11(0,11)E	214068.874	(3.646)	10(1,10) - 9(0, 9)E
197763.433	(2.834)	3(2, 1) - 2(1, 1)E	214362.113	(8.242)	11(3, 8) - 10(3, 8)E
197911.961	(2.778)	3(2, 2) - 2(1, 1)A	214443.816	(3.707)	10(1,10) - 9(0, 9)A
198345.824	(3.856)	9(2, 7) - 9(0, 9)E	214799.959	(6.313)	11(2, 9) - 10(2, 8)E
198693.473	(2.585)	9(1, 9) - 8(0, 8)E	214843.554	(6.311)	11(2, 9) - 10(2, 8)A
198953.906	(2.984)	3(2, 2) - 2(1, 2)E	215570.639	(2.642)	4(2, 3) - 3(1, 2)A
199093.166	(2.635)	9(1, 9) - 8(0, 8)A	215603.889	(2.722)	4(2, 2) - 3(1, 2)E
199177.652	(6.812)	11(2,10) - 11(0,11)A	216580.553	(5.928)	11(1,10) - 10(1, 9)E
199923.399	(9.067)	12(2,10) - 12(1,12)E	216630.056	(5.923)	11(1,10) - 10(1, 9)A
201045.425	(4.391)	10(2, 8) - 9(2, 8)E	218222.641	(8.882)	12(2,10) - 12(0,12)E
201196.865	(2.813)	3(2, 1) - 2(1, 2)A	219815.462	(2.948)	4(2, 3) - 3(1, 3)E
201290.539	(3.005)	3(2, 1) - 2(1, 2)E	221835.508	(9.498)	12(3,10) - 12(2,10)E
201376.251	(8.732)	12(2,11) - 12(0,12)E	222150.342	(2.780)	4(2, 2) - 3(1, 3)E
202433.637	(6.433)	11(2,10) - 10(2, 8)E	222229.772	(2.697)	4(2, 2) - 3(1, 3)A
202884.132	(8.787)	12(2,11) - 12(0,12)A	223638.942	(6.309)	11(2, 9) - 10(2, 9)E
203402.969	(5.042)	10(2, 8) - 10(0,10)E	223647.264	(6.354)	12(1,12) - 11(1,11)E
205086.411	(6.540)	12(0,12) - 11(1,11)A	223660.720	(6.349)	12(1,12) - 11(1,11)A

Table 6. Microwave transitions of $^{12}CH_3{}^{12}CH^{16}O$ in order of frequency—Continued

Frequency (MHz)	Unc.	J' K'₋ K'₊ - J" K"₋ K"₊ S	Frequency (MHz)	Unc.	J' K'₋ K'₊ - J" K"₋ K"₊ S
223909.819	(9.469)	12(3, 9) - 12(2,10)E	232100.413	(5.814)	4(3, 2) - 4(2, 2)E
224650.323	(9.484)	12(3, 9) - 12(2,10)A	232457.956	(5.307)	8(3, 5) - 8(2, 6)E
224706.566	(4.000)	2(2, 1) - 1(0, 1)E	232585.193	(15.336)	4(4, 1) - 5(3, 3)E
224880.771	(7.998)	11(3, 9) - 11(2, 9)E	232694.185	(2.477)	5(2, 4) - 4(1, 3)A
226548.631	(6.421)	12(0,12) - 11(0,11)E	232948.756	(15.470)	4(4, 1) - 5(3, 2)A
226593.394	(6.416)	12(0,12) - 11(0,11)A	232954.097	(15.467)	4(4, 0) - 5(3, 3)A
226857.517	(8.095)	11(3, 8) - 11(2, 9)E	232979.896	(2.547)	5(2, 3) - 4(1, 3)E
227052.890	(3.724)	2(2, 0) - 1(0, 1)E	233123.226	(5.124)	8(3, 5) - 8(2, 6)A
227295.363	(6.734)	10(3, 8) - 10(2, 8)E	233340.469	(4.922)	7(3, 4) - 7(2, 5)E
227509.344	(8.010)	11(3, 8) - 11(2, 9)A	233823.426	(10.402)	12(3, 9) - 11(3, 9)E
227556.929	(3.740)	2(2, 0) - 1(0, 1)A	233843.311	(4.831)	6(3, 3) - 6(2, 4)E
228760.496	(30.926)	9(5, 5) - 10(4, 6)E	234088.245	(4.976)	5(3, 2) - 5(2, 3)E
229134.192	(5.758)	9(3, 7) - 9(2, 7)E	234143.598	(4.786)	7(3, 4) - 7(2, 5)A
229257.374	(6.924)	10(3, 7) - 10(2, 8)E	234194.678	(5.244)	4(3, 1) - 4(2, 2)E
229426.643	(5.077)	11(1,11) - 10(0,10)E	234237.361	(5.538)	3(3, 0) - 3(2, 1)E
229619.733	(31.255)	9(5, 5) - 10(4, 6)A	234383.223	(4.560)	6(3, 4) - 6(2, 5)E
229624.795	(31.250)	9(5, 4) - 10(4, 7)A	234394.145	(4.772)	5(3, 3) - 5(2, 4)E
229772.370	(10.235)	12(3,10) - 11(3, 8)E	234435.292	(5.070)	4(3, 2) - 4(2, 3)E
229774.858	(5.147)	11(1,11) - 10(0,10)A	234466.537	(5.377)	3(3, 1) - 3(2, 2)E
229857.053	(6.768)	10(3, 7) - 10(2, 8)A	234483.941	(4.540)	7(3, 5) - 7(2, 6)E
230267.947	(31.168)	9(5, 4) - 10(4, 7)E	234780.145	(4.832)	8(3, 6) - 8(2, 7)E
230299.874	(8.311)	12(2,11) - 11(2,10)A	234794.378	(8.663)	12(2,10) - 11(2, 9)E
230314.310	(8.321)	12(2,11) - 11(2,10)E	234824.215	(8.658)	12(2,10) - 11(2, 9)A
230451.592	(5.141)	8(3, 6) - 8(2, 6)E	234842.563	(4.748)	6(3, 3) - 6(2, 4)A
230596.457	(2.734)	5(2, 4) - 4(1, 3)E	235289.635	(4.920)	5(3, 2) - 5(2, 3)A
231113.821	(5.983)	9(3, 6) - 9(2, 7)E	235320.773	(5.507)	9(3, 7) - 9(2, 8)E
231165.045	(51.225)	12(11, 1) - 11(11, 0)E	235551.006	(5.200)	4(3, 1) - 4(2, 2)A
231174.393	(43.306)	12(10, 2) - 11(10, 1)E	235685.603	(5.503)	3(3, 0) - 3(2, 1)A
231192.465	(36.160)	12(9, 3) - 11(9, 2)E	235775.378	(5.492)	3(3, 1) - 3(2, 2)A
231197.368	(51.210)	12(11, 1) - 11(11, 0)A	235819.312	(5.168)	4(3, 2) - 4(2, 3)A
231197.368	(51.210)	12(11, 2) - 11(11, 1)A	235912.324	(4.847)	5(3, 3) - 5(2, 4)A
231197.670	(36.156)	12(9, 4) - 11(9, 3)E	235994.576	(8.185)	12(1,11) - 11(1,10)E
231198.342	(43.301)	12(10, 3) - 11(10, 2)E	236048.795	(8.180)	12(1,11) - 11(1,10)A
231198.922	(29.795	12(8, 4) - 11(8, 3)E	236078.762	(4.612)	6(3, 4) - 6(2, 5)A
231207.219	(51.211)	12(11, 2) - 11(11, 1)E	236134.346	(6.570)	10(3, 8) - 10(2, 9)E
231218.242	(43.291)	12(10, 2) - 11(10, 1)A	236346.815	(4.578)	7(3, 5) - 7(2, 6)A
231218.242	(43.291)	12(10, 3) - 11(10, 2)A	236440.389	(5.386)	6(3, 3) - 6(2, 5)E
231225.221	(24.206)	12(7, 5) - 11(7, 4)E	236471.683	(5.718)	5(3, 2) - 5(2, 4)E
231230.797	(29.779)	12(8, 5) - 11(8, 4)E	236517.137	(5.183)	7(3, 4) - 7(2, 6)E
231232.715	(36.147)	12(9, 3) - 11(9, 2)A	236529.557	(6.074)	4(3, 1) - 4(2, 3)E
231232.715	(36.147)	12(9, 4) - 11(9, 3)A	236747.972	(4.865)	8(3, 6) - 8(2, 7)A
231240.829	(29.780)	12(8, 4) - 11(8, 3)A	236786.510	(5.281)	8(3, 5) - 8(2, 7)E
231240.829	(29.780)	12(8, 5) - 11(8, 4)A	237247.093	(7.982)	11(3, 9) - 11(2,10)E
231249.315	(24.198)	12(7, 6) - 11(7, 5)A	237300.403	(5.797)	9(3, 6) - 9(2, 8)E
231249.315	(24.198)	12(7, 5) - 11(7, 4)A	237316.410	(5.543)	9(3, 7) - 9(2, 8)A
231269.052	(24.190)	12(7, 6) - 11(7, 5)E	238088.335	(6.606)	10(3, 8) - 10(2, 9)A
231271.539	(19.411)	12(6, 7) - 11(6, 6)A	238096.357	(6.737)	10(3, 7) - 10(2, 9)E
231271.541	(19.411)	12(6, 6) - 11(6, 5)A	238681.899	(9.697)	12(3,10) - 12(2,11)E
231276.725	(19.404)	12(6, 6) - 11(6, 5)E	239101.282	(8.012)	11(3, 9) - 11(2,10)A
231307.273	(4.929)	7(3, 5) - 7(2, 5)E	239223.839	(8.050)	11(3, 8) - 11(2,10)E
231312.232	(19.396)	12(6, 7) - 11(6, 6)E	240393.398	(9.721)	12(3,10) - 12(2,11)A
231328.405	(15.428)	12(5, 8) - 11(5, 7)A	240756.209	(9.685)	12(3, 9) - 12(2,11)E
231328.559	(15.428)	12(5, 7) - 11(5, 6)A	241317.816	(2.792)	5(2, 4) - 4(1, 4)E
231361.355	(15.410)	12(5, 7) - 11(5, 6)E	243701.255	(2.530)	5(2, 3) - 4(1, 4)E
231371.730	(15.409)	12(5, 8) - 11(5, 7)E	243969.914	(2.527)	5(2, 3) - 4(1, 4)A
231420.155	(15.193)	4(4, 0) - 5(3, 2)E	244029.692	(3.908)	3(2, 2) - 2(0, 2)E
231453.629	(12.262)	12(4, 9) - 11(4, 8)A	244847.873	(6.877)	12(1,12) - 11(0,11)E
231464.394	(12.258)	12(4, 8) - 11(4, 7)A	245167.702	(6.955)	12(1,12) - 11(0,11)A
231485.122	(12.248)	12(4, 8) - 11(4, 7)E	246366.325	(3.634)	3(2, 1) - 2(0, 2)E
231505.854	(12.243)	12(4, 9) - 11(4, 8)E	246906.477	(3.663)	3(2, 1) - 2(0, 2)A
231591.989	(9.946)	12(3,10) - 11(3, 9)A	247429.403	(2.554)	6(2, 5) - 5(1, 4)E
231713.990	(5.972)	9(3, 6) - 9(2, 7)A	248114.233	(31.860)	8(5, 4) - 9(4, 5)E
231749.116	(9.942)	12(3,10) - 11(3, 9)E	248985.328	(32.187)	8(5, 4) - 9(4, 5)A
231786.146	(5.071)	6(3, 4) - 6(2, 4)E	248987.498	(32.184)	8(5, 3) - 9(4, 6)A
231846.680	(9.912)	12(3, 9) - 11(3, 8)E	249286.478	(2.443)	6(2, 5) - 5(1, 4)A
231965.195	(9.906)	12(3, 9) - 11(3, 8)A	249646.845	(32.090)	8(5, 3) - 9(4, 6)E
232010.706	(5.413)	5(3, 3) - 5(2, 3)E	250026.480	(2.434)	6(2, 4) - 5(1, 4)E

Table 7. Additional measured transition frequencies (MHz) Ref. [75A].

J' K'_- K'_+ ← J" K''_- K''_+ S	Frequency	Unc.
13(2,11) - 12(3,10)A	31132.798	(0.02)
13(2,11) - 12(3,10)E	32996.136	(0.02)
13(2,12) - 12(3,10)E	10649.654	(0.02)
13(2,12) - 12(3, 9)A	7984.916	(0.02)
13(2,12) - 12(3, 9)E	8570.750	(0.02)
13(2,11) - 12(3, 9)E	30917.169	(0.02)
13(2,11) - 13(2,12)A	22208.557	(0.02)
13(2,11) - 13(2,12)E	22346.502	(0.02)
14(2,13) - 13(3,10)A	24802.202	(0.02)
14(2,13) - 13(3,10)E	25500.677	(0.02)
14(2,12) - 14(2,13)A	28797.955	(0.02)
14(2,12) - 14(2,13)E	28920.466	(0.02)
15(2,13) - 15(2,14)A	36489.366	(0.02)
15(2,13) - 15(2,14)E	36602.044	(0.02)
18(3,15) - 18(3,16)A	9549.303	(0.02)
18(3,15) - 18(3,16)E	9722.492	(0.02)
19(3,16) - 19(3,17)A	12873.798	(0.02)
19(3,16) - 19(3,17)E	13025.707	(0.02)
20(3,17) - 20(3,18)A	17018.103	(0.02)
20(3,17) - 20(3,18)E	17163.112	(0.02)
21(3,18) - 21(3,19)A	22087.125	(0.02)
21(3,18) - 21(3,19)E	22234.413	(0.02)
22(3,19) - 22(3,20)A	28175.655	(0.02)
22(3,19) - 22(3,20)E	28330.732	(0.02)
23(3,20) - 23(3,21)A	35363.704	(0.02)
23(3,20) - 23(3,21)E	35529.199	(0.02)

3.1. CH_3CHO References

a. References to the Tables

[57A] R. W. Kilb, C. C. Lin, and E. B. Wilson, Jr., J. Chem. Phys. **26**, 1695 (1957). "Calculation of Energy Levels for Internal Torsion and Over-All Rotation. II. CH_3CHO Type Molecules; Acetaldehyde Spectra."

[73A] P. Nösberger, A. Bauder, and Hs. H. Günthard, Chem. Phys. **1**, 418 (1973). "A Versatile Method for Molecular Structure Determinations from Ground State Rotational Constants."

[73B] C. A. Gottlieb in *Molecules in the Galactic Environment.* Eds. M. A. Gordon and L. E. Snyder, (Wiley-Interscience, New York, 1973) p. 181. "Detection of Acetaldehyde in Sagitarius."

[74A] N. Fourikis, M. W. Sinclair, B. J. Robinson, P. D. Godfrey, and R. D. Brown, Aust. J. Phys. **27**, 425 (1974). "Microwave Emission of the $2_{11} \rightarrow 2_{12}$ Rotational Transition in Interstellar Acetaldehyde."

[75A] A. Bauder and Hs. H. Günthard, J. Mol. Spectrosc., to be published. "Internal Rotation in Acetaldehyde."

[75B] W. Gilmore, M. Morris, D. R. Johnson, F. J. Lovas, B. Zuckerman, B. E. Turner, and P. Palmer, Astrophys. J., to be published. "Observation of the 6_{16}–5_{15} Transition of Acetaldehyde in Sgr B2."

[75C] D. R. Johnson and F. J. Lovas, 1975. These measurements were performed after the present analysis was completed and were not included in the fit.

b. Other References

C. C. Lin and R. W. Kilb, J. Chem. Phys. **24**, 631 (1956). "Microwave Spectrum and Internal Barrier of Acetaldehyde."

P. H. Verdier and E. B. Wilson, Jr., J. Chem. Phys. **29**, 340 (1958). "Relative Intensities of Microwave Absorption Lines."

D. R. Herschbach, J. Chem. Phys. **31**, 91 (1959). "Calculation of Energy Levels for Internal Torsion and Over-All Rotation. III."

C. R. Quade and C. C. Lin, J. Chem. Phys. **38**, 540 (1963). "Internal Rotation in Completely Asymmetric Molecules. I. A General Theory and Analysis of the Microwave Rotation Spectrum of CH_2DCHO, CD_2HCOH, and $CHOOCH_2D$."

C. R. Quade, J. Chem. Phys. **44**, 2512 (1966). "Internal Rotation in Completely Asymmetric Molecules. II. Interactions between Vibration and Internal Rotation."

H. Dreizler, Z. Naturforsch. **21a**, 621 (1966). "Zur Aktivität von Methyltorsionschwingungen."

T. Iijima and M. Kimura, Bull. Chem. Soc. Japan **42**, 2159 (1969). "Zero-point Average Structure of Acetaldehyde."

W. Hüttner and W. H. Flygare, Trans. Faraday Soc. **65**, 1953 (1969). "Molecular *g*-Values, Magnetic Susceptibility Anisotropies, Second Moment of the Charge Distribution and Molecular Quadrupole Moments in Acetaldehyde."

C. E. Souter and J. L. Wood, J. Chem. Phys. **52**, 674 (1970). "Combined Infrared and Microwave Determination of Torsional Parameters."

H. Hollenstein and Hs. H. Günthard, Spectrochim. Acta **27A**, 2027 (1971). "Solid State and Gas Infrared Spectra and Normal Coordinate Analysis of 5 Isotopic Species of Acetaldehyde."

T. Iijima and S. Tsuchita, J. Mol. Spectrosc. **44**, 88 (1972). "Zero-point Average Structure of a Molecule Containing a Symmetric Internal Rotor."