NEC

SILICON TRANSISTOR
2SC5178

NPN EPITAXIAL SILICON TRANSISTOR IN 4-PIN MINI-MOLD PACKAGE FOR LOW-NOISE MICROWAVE AMPLIFICATION

FEATURES

- Low current consumption and high gain
  $|S_{21e}|^2$ = 11.5 dB TYP. @ V_{CE} = 2 V, I_C = 7 mA, f = 2 GHz
  $|S_{21e}|^2$ = 10.5 dB TYP. @ V_{CE} = 1 V, I_C = 5 mA, f = 2 GHz
- 4-pin Mini-Mold package
  EIAJ: SC-61

ORDERING INFORMATION

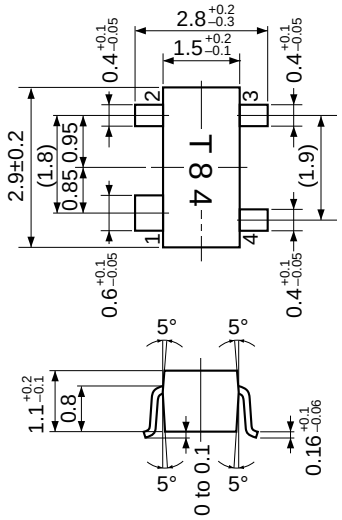
PART NUMBER	QUANTITY	ARRANGEMENT
2SC5178-T1	3000 units/reel	Embossed tape, 8 mm wide, pins No. 3 (base) and No. 4 (emitter) facing the perforations
2SC5178-T2	3000 units/reel	Embossed tape, 8 mm wide, pins No. 1 (collector) and No. 2 (emitter) facing the perforations

* Contact your NEC sales representatives to order samples for evaluation (available in batches of 50).

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C)

Collector to Base Voltage	V_{CBO}	5	V
Collector to Emitter Voltage	V_{CEO}	3	V
Emitter to Base Voltage	V_{EBO}	2	V
Collector Current	I_C	10	mA
Total Power Dissipation	P_T	30	mW
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	–65 to +150	°C

PACKAGE DIMENSIONS
(Units: mm)



PIN CONNECTIONS
1. Collector
2. Emitter
3. Base
4. Emitter

CAUTION; This transistor uses high-frequency technology. Be careful not to allow excessive current to flow through the transistor, including static electricity.

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ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Collector Cutoff Current	I_{CBO}			100	nA	V_{CB} = 5 V, I_E = 0
Emitter Cutoff Current	I_{EBO}			100	nA	V_{EB} = 1 V, I_C = 0
DC Current Gain	h_{FE}	70		140		V_{CE} = 2 V, I_C = 7 mA***1**
Insertion Power Gain (1)	$\|S_{21e}\|^2$	9.5	11.5		dB	V_{CE} = 2 V, I_C = 7 mA, f = 2 GHz
Insertion Power Gain (2)	$\|S_{21e}\|^2$	7.5	10.5		dB	V_{CE} = 1 V, I_C = 5 mA, f = 2 GHz
Noise Figure (1)	NF		1.5	2.0	dB	V_{CE} = 2 V, I_C = 3 mA, f = 2 GHz
Noise Figure (2)	NF		1.5	2.0	dB	V_{CE} = 1 V, I_C = 3 mA, f = 2 GHz
Gain Bandwidth Product (1)	f_T	10.5	13.5		GHz	V_{CE} = 2 V, I_C = 7 mA, f = 2 GHz
Gain Bandwidth Product (2)	f_T	8.5	12		GHz	V_{CE} = 1 V, I_C = 5 mA, f = 2 GHz
Feedback Capacitance	C_{re}		0.3	0.5	pF	V_{CB} = 2 V, I_E = 0 mA, f = 1 MHz***2**

***1.** Measured with pulses: Pulse width ≤ 350 μs, duty cycle ≤ 2 %, pulsed

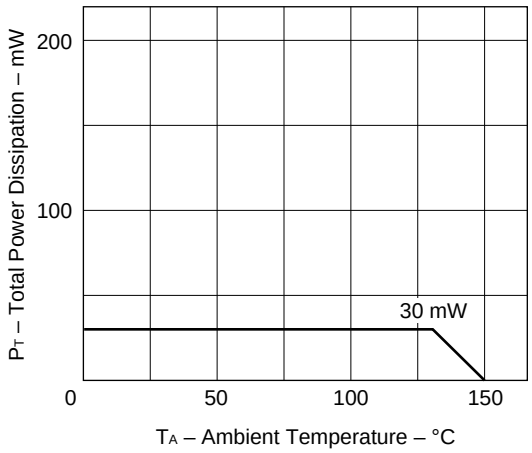
***2.** Measured with a three-terminal bridge. The emitter and case terminal are connected to the guard terminal of the bridge.

h_{FE} Class

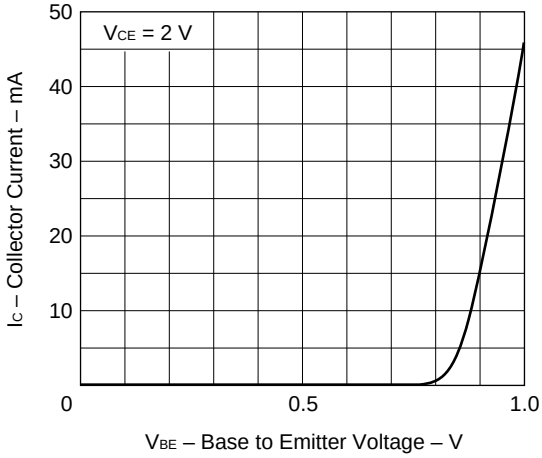
Class	FB
Marking	T84
h_{FE}	70 to 140

CHARACTERISTICS CURVES (T_A = 25 °C)

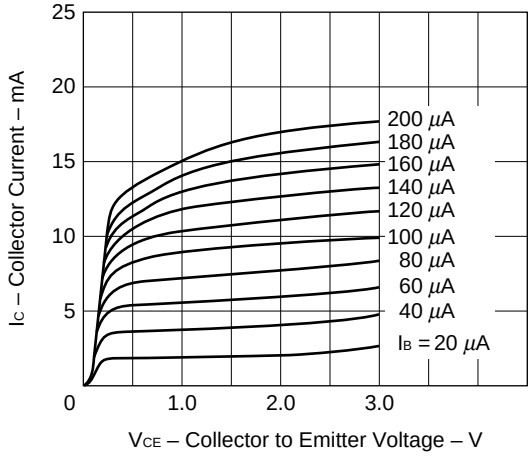
TOTAL POWER DISSIPATION vs.
AMBIENT TEMPERATURE



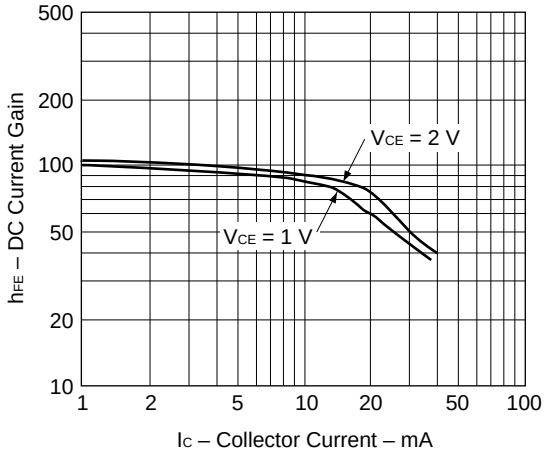
COLLECTOR CURRENT vs.
BASE TO EMITTER VOLTAGE



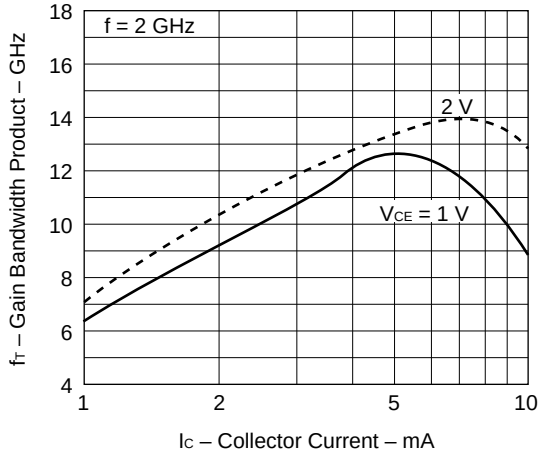
COLLECTOR CURRENT vs.
COLLECTOR TO EMITTER VOLTAGE



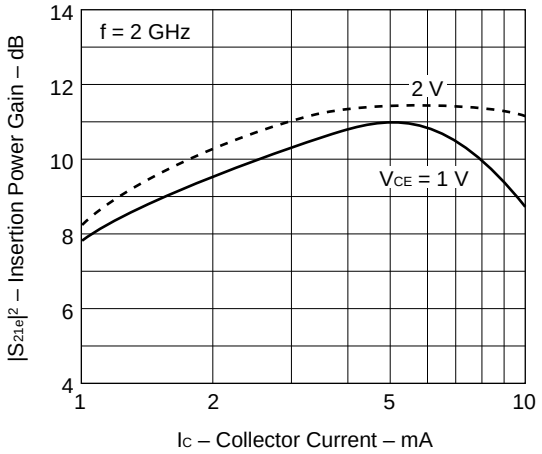
DC CURRENT GAIN vs.
COLLECTOR CURRENT



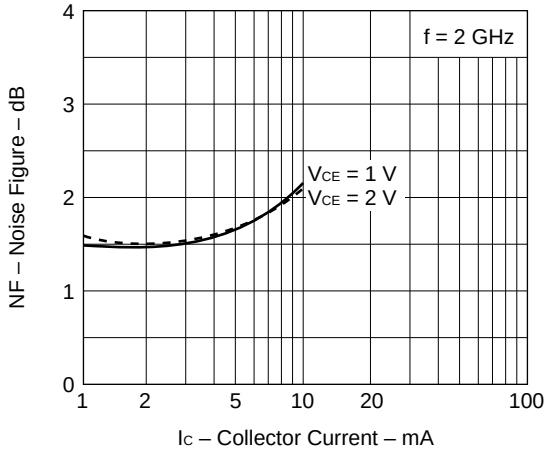
GAIN BANDWIDTH PRODUCT vs.
COLLECTOR CURRENT



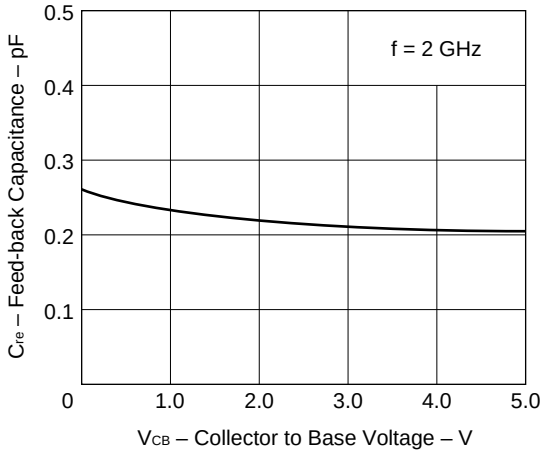
INSERTION POWER GAIN vs.
COLLECTOR CURRENT



NOISE FIGURE vs.
COLLECTOR CURRENT



FEED-BACK CAPACITANCE vs.
COLLECTOR TO BASE VOLTAGE



S-PARAMETER

V_{CE} = 1 V, I_C = 1 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.954	–9.5	3.362	168.9	0.026	77.0	0.989	–6.9
400.00	0.933	–19.1	3.305	158.2	0.061	76.5	0.972	–13.5
600.00	0.902	–28.3	3.251	148.3	0.084	68.1	0.941	–20.5
800.00	0.855	–38.2	3.204	137.6	0.106	63.3	0.917	–27.6
1000.00	0.798	–48.3	3.113	126.9	0.150	54.1	0.890	–34.5
1200.00	0.739	–59.2	3.032	116.5	0.170	53.5	0.842	–40.8
1400.00	0.667	–69.1	2.892	107.3	0.178	45.2	0.769	–47.5
1600.00	0.597	–77.4	2.719	96.6	0.195	37.7	0.729	–52.4
1800.00	0.519	–87.9	2.626	88.5	0.213	31.8	0.675	–60.3
2000.00	0.472	–97.7	2.484	80.5	0.223	31.7	0.634	–64.6
2200.00	0.413	–110.8	2.345	72.8	0.233	24.9	0.582	–70.9
2400.00	0.365	–123.4	2.255	64.6	0.238	18.9	0.530	–77.0
2600.00	0.306	–135.0	2.169	58.1	0.249	14.2	0.496	–83.0
2800.00	0.280	–154.3	2.015	51.3	0.254	14.6	0.452	–88.0
3000.00	0.259	–174.4	1.982	44.3	0.239	10.0	0.461	–99.2

V_{CE} = 1 V, I_C = 3 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.878	–16.5	8.193	161.7	0.030	68.5	0.968	–11.6
400.00	0.789	–31.1	7.559	145.1	0.054	72.2	0.899	–22.2
600.00	0.694	–45.0	6.833	130.9	0.075	64.4	0.816	–30.8
800.00	0.589	–56.7	6.147	118.1	0.095	53.7	0.727	–38.1
1000.00	0.501	–69.1	5.496	106.8	0.115	53.5	0.673	–45.4
1200.00	0.423	–80.2	4.936	96.9	0.120	52.5	0.600	–49.8
1400.00	0.340	–90.7	4.427	88.7	0.140	47.1	0.537	–54.3
1600.00	0.280	–100.1	3.975	80.0	0.141	41.7	0.496	–60.1
1800.00	0.221	–114.0	3.672	73.1	0.163	40.1	0.437	–66.0
2000.00	0.196	–125.8	3.347	66.4	0.181	34.6	0.419	–69.6
2200.00	0.157	–142.7	3.066	60.4	0.176	33.4	0.374	–75.8
2400.00	0.160	–168.6	2.893	53.8	0.199	30.6	0.333	–76.7
2600.00	0.135	162.2	2.715	48.4	0.202	28.2	0.304	–85.6
2800.00	0.181	148.5	2.530	42.5	0.214	29.8	0.284	–92.0
3000.00	0.204	127.6	2.438	36.8	0.218	24.2	0.287	–99.7

V_{CE} = 1 V, I_C = 5 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.801	–21.6	11.278	156.4	0.030	69.6	0.935	–14.8
400.00	0.677	–39.6	9.808	136.7	0.049	71.2	0.833	–26.4
600.00	0.557	–53.2	8.302	121.4	0.063	58.9	0.717	–35.2
800.00	0.451	–66.4	7.123	108.9	0.091	56.5	0.628	–40.7
1000.00	0.358	–76.9	6.140	98.1	0.095	51.6	0.577	–45.8
1200.00	0.277	–90.1	5.377	89.3	0.107	49.9	0.503	–50.4
1400.00	0.222	–100.7	4.737	81.6	0.122	47.7	0.454	–52.6
1600.00	0.172	–113.7	4.198	74.0	0.144	44.3	0.419	–55.7
1800.00	0.115	–135.4	3.838	67.7	0.153	44.1	0.376	–61.9
2000.00	0.111	–151.0	3.476	61.8	0.159	43.0	0.346	–66.5
2200.00	0.118	–173.9	3.178	56.1	0.182	35.9	0.308	–71.1
2400.00	0.121	159.2	2.982	50.4	0.195	38.3	0.280	–79.3
2600.00	0.142	137.2	2.795	45.1	0.191	36.9	0.264	–83.8
2800.00	0.181	128.6	2.589	39.5	0.226	28.0	0.242	–87.0
3000.00	0.210	108.6	2.489	34.1	0.237	28.0	0.239	–100.8

V_{CE} = 1 V, I_C = 7 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.732	–26.3	13.376	152.5	0.024	74.3	0.900	–16.6
400.00	0.593	–44.8	10.989	130.9	0.047	67.6	0.782	–28.3
600.00	0.453	–59.2	8.954	115.8	0.060	67.1	0.664	–35.6
800.00	0.341	–71.0	7.441	103.6	0.075	60.2	0.585	–40.4
1000.00	0.254	–83.3	6.267	93.7	0.094	58.6	0.530	–43.6
1200.00	0.193	–95.5	5.441	85.6	0.103	56.9	0.476	–47.5
1400.00	0.144	–112.2	4.757	78.5	0.120	51.4	0.434	–50.8
1600.00	0.118	–136.4	4.207	71.4	0.129	50.9	0.405	–53.5
1800.00	0.088	–159.6	3.814	65.8	0.140	46.9	0.363	–58.7
2000.00	0.084	–178.8	3.464	60.2	0.155	45.9	0.334	–64.2
2200.00	0.099	148.2	3.167	54.8	0.174	41.3	0.315	–67.2
2400.00	0.134	127.4	2.939	49.3	0.180	40.2	0.290	–73.0
2600.00	0.175	117.8	2.771	44.7	0.187	38.8	0.274	–79.0
2800.00	0.212	112.4	2.578	39.6	0.206	32.0	0.266	–82.0
3000.00	0.265	109.7	2.476	33.9	0.229	31.0	0.264	–90.8

V_{CE} = 2 V, I_C = 1 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.955	–8.7	3.382	169.5	0.029	81.7	0.997	–6.3
400.00	0.941	–17.7	3.329	159.3	0.054	77.2	0.976	–12.6
600.00	0.899	–25.9	3.274	149.7	0.075	71.5	0.953	–19.0
800.00	0.864	–35.3	3.246	139.5	0.102	65.9	0.927	–25.7
1000.00	0.824	–45.2	3.188	129.4	0.121	60.3	0.901	–31.9
1200.00	0.757	–54.2	3.101	119.3	0.143	54.1	0.860	–37.5
1400.00	0.695	–63.4	2.976	110.2	0.168	43.6	0.800	–44.8
1600.00	0.623	–73.6	2.797	99.8	0.177	40.5	0.760	–50.0
1800.00	0.548	–81.4	2.721	91.7	0.198	37.2	0.717	–56.2
2000.00	0.503	–92.5	2.601	83.9	0.198	32.3	0.670	–61.8
2200.00	0.429	–102.0	2.430	76.0	0.201	28.3	0.616	–66.6
2400.00	0.392	–112.4	2.376	68.4	0.228	23.9	0.561	–72.4
2600.00	0.310	–127.2	2.269	61.2	0.221	20.4	0.524	–77.6
2800.00	0.289	–140.6	2.134	54.4	0.224	13.3	0.509	–82.8
3000.00	0.248	–159.0	2.112	48.0	0.228	10.6	0.498	–90.5

V_{CE} = 2 V, I_C = 3 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.877	–14.6	8.210	162.6	0.026	74.3	0.971	–10.2
400.00	0.807	–28.4	7.644	147.0	0.049	78.5	0.924	–19.7
600.00	0.723	–40.8	6.973	133.6	0.070	67.8	0.850	–28.0
800.00	0.624	–52.1	6.331	120.8	0.087	56.4	0.771	–34.5
1000.00	0.531	–61.9	5.727	109.6	0.101	54.9	0.703	–40.6
1200.00	0.442	–72.6	5.160	100.0	0.116	49.8	0.651	–45.6
1400.00	0.380	–80.4	4.647	91.6	0.122	47.8	0.589	–50.6
1600.00	0.292	–88.6	4.192	83.0	0.138	44.6	0.525	–54.8
1800.00	0.249	–98.4	3.880	76.1	0.153	40.2	0.487	–60.1
2000.00	0.208	–112.1	3.553	69.5	0.161	42.0	0.461	–63.6
2200.00	0.167	–122.0	3.276	63.0	0.172	37.5	0.427	–68.2
2400.00	0.142	–144.3	3.074	56.9	0.191	36.8	0.392	–72.2
2600.00	0.115	–170.2	2.915	51.4	0.180	33.3	0.359	–80.1
2800.00	0.140	165.8	2.697	45.6	0.192	28.3	0.332	–85.2
3000.00	0.154	134.5	2.606	40.2	0.203	26.6	0.330	–91.8

V_{CE} = 2 V, I_C = 5 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.802	–18.8	11.437	157.7	0.026	89.7	0.945	–12.9
400.00	0.700	–35.7	10.038	138.7	0.044	66.9	0.862	–23.3
600.00	0.588	–47.4	8.649	124.1	0.061	68.2	0.760	–31.0
800.00	0.483	–59.2	7.480	111.5	0.082	58.5	0.673	–37.1
1000.00	0.387	–68.4	6.479	100.9	0.102	56.1	0.612	–42.0
1200.00	0.308	–78.3	5.695	92.0	0.101	52.1	0.559	–46.1
1400.00	0.258	–86.5	5.044	84.5	0.119	53.7	0.496	–48.7
1600.00	0.193	–94.3	4.494	76.8	0.134	48.5	0.460	–52.0
1800.00	0.139	–110.4	4.112	70.8	0.147	49.4	0.417	–55.2
2000.00	0.116	–120.7	3.746	64.7	0.145	43.7	0.403	–60.2
2200.00	0.075	–143.0	3.429	59.1	0.168	40.5	0.368	–64.4
2400.00	0.094	–174.9	3.204	53.1	0.186	40.7	0.329	–69.5
2600.00	0.086	149.7	3.040	48.0	0.196	35.9	0.307	–76.1
2800.00	0.131	125.6	2.805	42.8	0.201	37.7	0.296	–77.7
3000.00	0.164	116.1	2.701	37.2	0.237	32.4	0.276	–86.6

V_{CE} = 2 V, I_C = 7 mA, Z_O = 50 Ω

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
(MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
200.00	0.754	–22.1	13.572	154.1	0.025	79.8	0.925	–14.3
400.00	0.620	–39.0	11.414	133.6	0.042	66.8	0.823	–24.8
600.00	0.501	–50.8	9.431	118.7	0.060	64.8	0.714	–31.5
800.00	0.376	–61.0	7.926	106.6	0.068	57.5	0.639	–37.0
1000.00	0.298	–70.4	6.730	96.7	0.086	58.3	0.587	–40.7
1200.00	0.224	–78.7	5.860	88.5	0.100	60.1	0.528	–43.5
1400.00	0.177	–87.7	5.137	81.7	0.106	57.2	0.487	–45.0
1600.00	0.132	–96.9	4.552	74.4	0.118	53.2	0.448	–48.8
1800.00	0.080	–108.7	4.145	69.0	0.131	53.1	0.421	–51.4
2000.00	0.058	–128.1	3.769	63.3	0.143	48.0	0.397	–57.7
2200.00	0.036	–178.5	3.425	57.9	0.166	45.1	0.378	–60.3
2400.00	0.067	145.7	3.217	52.8	0.161	46.8	0.341	–66.6
2600.00	0.104	122.4	3.026	48.0	0.183	39.2	0.321	–72.3
2800.00	0.141	118.8	2.819	43.2	0.197	36.6	0.310	–74.1
3000.00	0.205	107.8	2.735	37.7	0.193	33.2	0.321	–78.8

[MEMO]

[MEMO]

[MEMO]

M4 96.5