# KVN Amplitude Calibration

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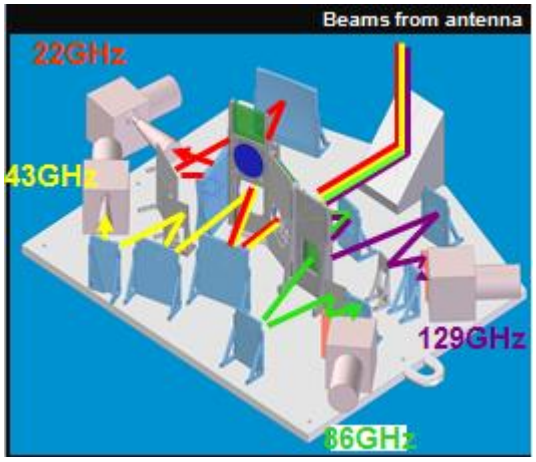
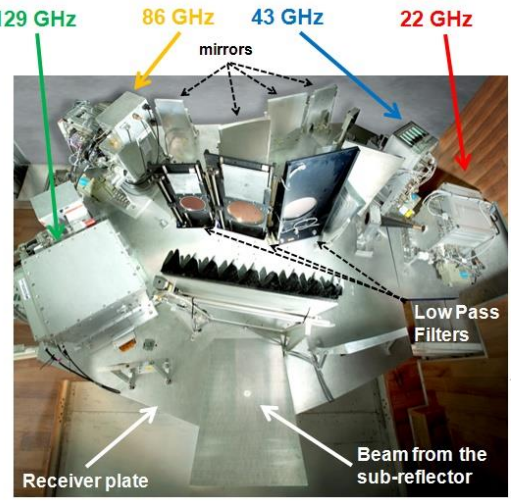
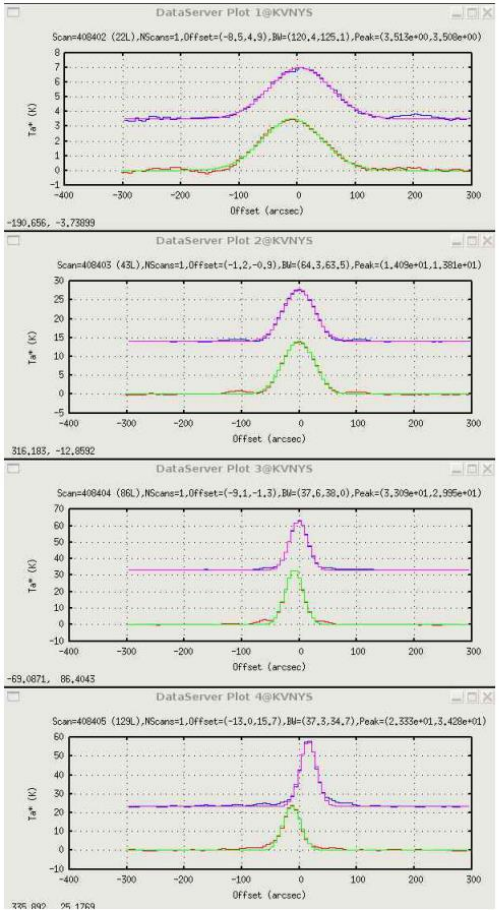
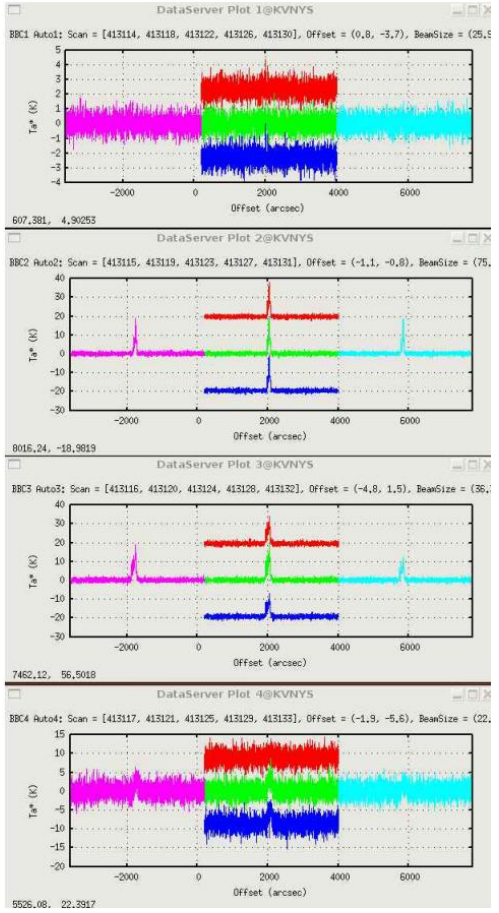
# KVN Calibration Procedures

1) obs. freq. setting
2) Test vector check
3) AGC
4) sky dipping
5) Focusing (masers at 8
6) pointing (auto/manual)
   - cross-scan using 22/43 GHz continuum source
   - five points with H2O/SiO masers at 22/43/86 GHz
7) Cal-chopper (Tsys) continuous Tsys monitoring (total power)



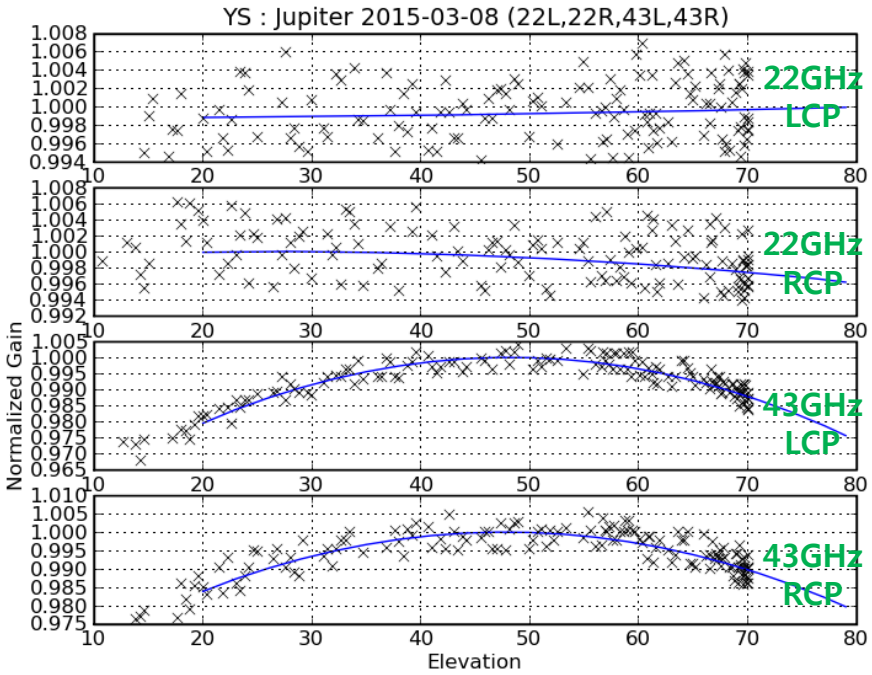



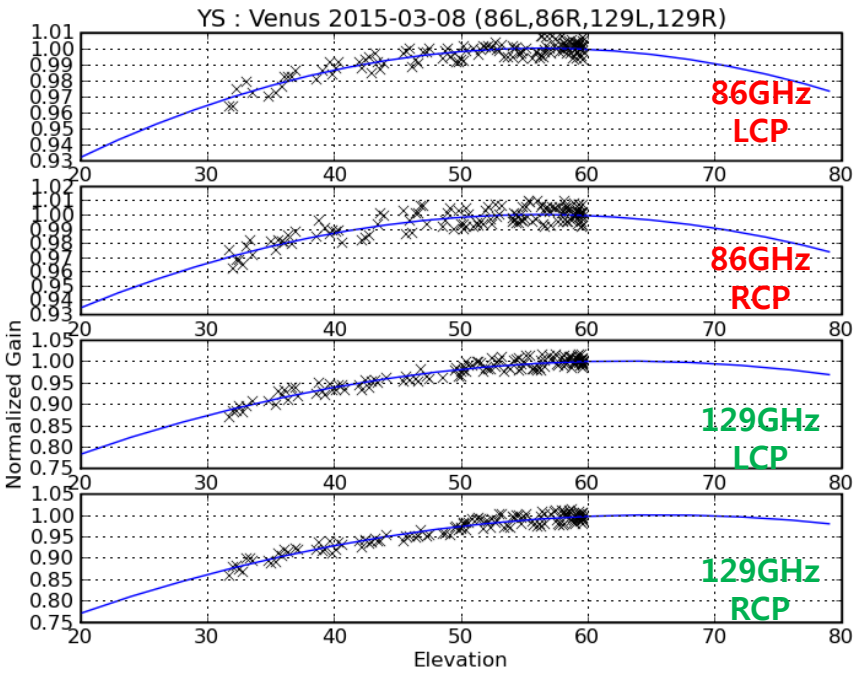



# EL dependence of Antenna Gain (KVN Yonsei)

(details: http://radio.kasi.re.kr/kvn/status_report_2015/gain_curve.html )

By fitting a second order polynomial to the data and normalizing the fitted function with its maximum, we derived a normalized gain curve which has the following form: G_norm = A0*EL^2 + A1*EL + A2, where EL is the elevation in degree.




(measured on 2015 Mar 03)

# Gain Table

| | Yonsei | | | Ulsan | | | Tamna | | |
|---|---|---|---|---|---|---|---|---|---|
| | A0 | A1 | A2 | A0 | A1 | A2 | A0 | A1 | A2 |
| 22L | 1.23e-07 | 6.93e-06 | 9.99e-01 | 2.17e-06 | -2.63e-04 | 1.00e+00 | -2.40e-06 | 2.81e-04 | 9.92e-01 |
| 22R | -1.32e-06 | 6.72e-05 | 9.99e-01 | 6.17e-06 | -6.78e-04 | 1.01e+00 | -2.94e-06 | 3.52e-04 | 9.89e-01 |
| 43L | -2.56e-05 | 2.47e-03 | 9.41e-01 | 2.03e-06 | -7.05e-04 | 1.01e+00 | -7.52e-06 | 7.30e-034 | 9.82e-01 |
| 43R | -2.08e-05 | 1.99e-03 | 9.52e-01 | 2.86e-06 | -7.72e-04 | 1.01e+00 | -1.13e-05 | 1.22e-03 | 9.67e-01 |
| 86L | -5.15e-05 | 5.79e-03 | 8.37e-01 | -4.78e-05 | 7.86e-04 | 1.00e+00 | -1.69e-04 | 1.58e-02 | 6.29e-01 |
| 86R | -4.98e-05 | 5.60e-03 | 8.43e-01 | -5.03e-05 | 8.92e-04 | 1.00e+00 | -1.80e-04 | 1.69e-02 | 6.03e-01 |
| 129L | -1.18e-04 | 1.45e-02 | 5.34e-01 | -1.36e-04 | 8.82e-03 | 8.57e-01 | -3.24e-04 | 3.13e-02 | 2.45e-01 |
| 129R | -1.11e-04 | 1.45e-02 | 5.26e-01 | -1.41e-04 | 9.10e-03 | 8.53e-01 | --- | --- | --- |

# HPBW & Aperture Efficiency

| Site | Band (GHz) | HPBW (arcsec) | Aperture Efficiency (%) | Beam Efficiency (%) |
|---|---|---|---|---|
| KVN-YS | 22L | 127 | 55 | 45 |
| | 22R | 126 | 57 | 46 |
| | 43L | 63 | 63 | 48 |
| | 43R | 63 | 64 | 48 |
| | 86L | 32 | 53 | 41 |
| | 86R | 32 | 52 | 41 |
| | 129L | 24 | 40 | 40 |
| | 129R | 24 | 40 | 40 |
| KVN-US | 22L | 124 | 63 | 49 |
| | 22R | 124 | 64 | 50 |
| | 43L | 63 | 61 | 46 |
| | 43R | 63 | 62 | 47 |
| | 86L | 33 | 48 | 40 |
| | 86R | 33 | 45 | 37 |
| | 129L | 23 | 33 | 30 |
| | 129R | 23 | 33 | 30 |
| KVN-TN | 22L | 126 | 60 | 48 |
| | 22R | 126 | 61 | 49 |
| | 43L | 63 | 63 | 48 |
| | 43R | 63 | 65 | 49 |
| | 86L | 32 | 50 | 39 |
| | 86R | 32 | 49 | 38 |
| | 129L | 23 | 33 | 30 |
| | 129R | -- | -- | -- |

Measured with planets
- Jupiter or Venus at 22,43GHz
- Venus or Mars at 86, 129GHz

details: http://radio.kasi.re.kr/kvn/status_report_2015/gain_curve.html

# Tsys calculation of KVN

- Optical depth $\tau$ is calculated from sky-dipping data
- KVN Tsys calculation takes into account forward spillover efficiency $\eta$~0.93

$$T_{sky} = \eta T_{atm}(1-e^{-\tau}) + (1-\eta) T_{spill} + \eta T_{cmb} e^{-\tau}$$

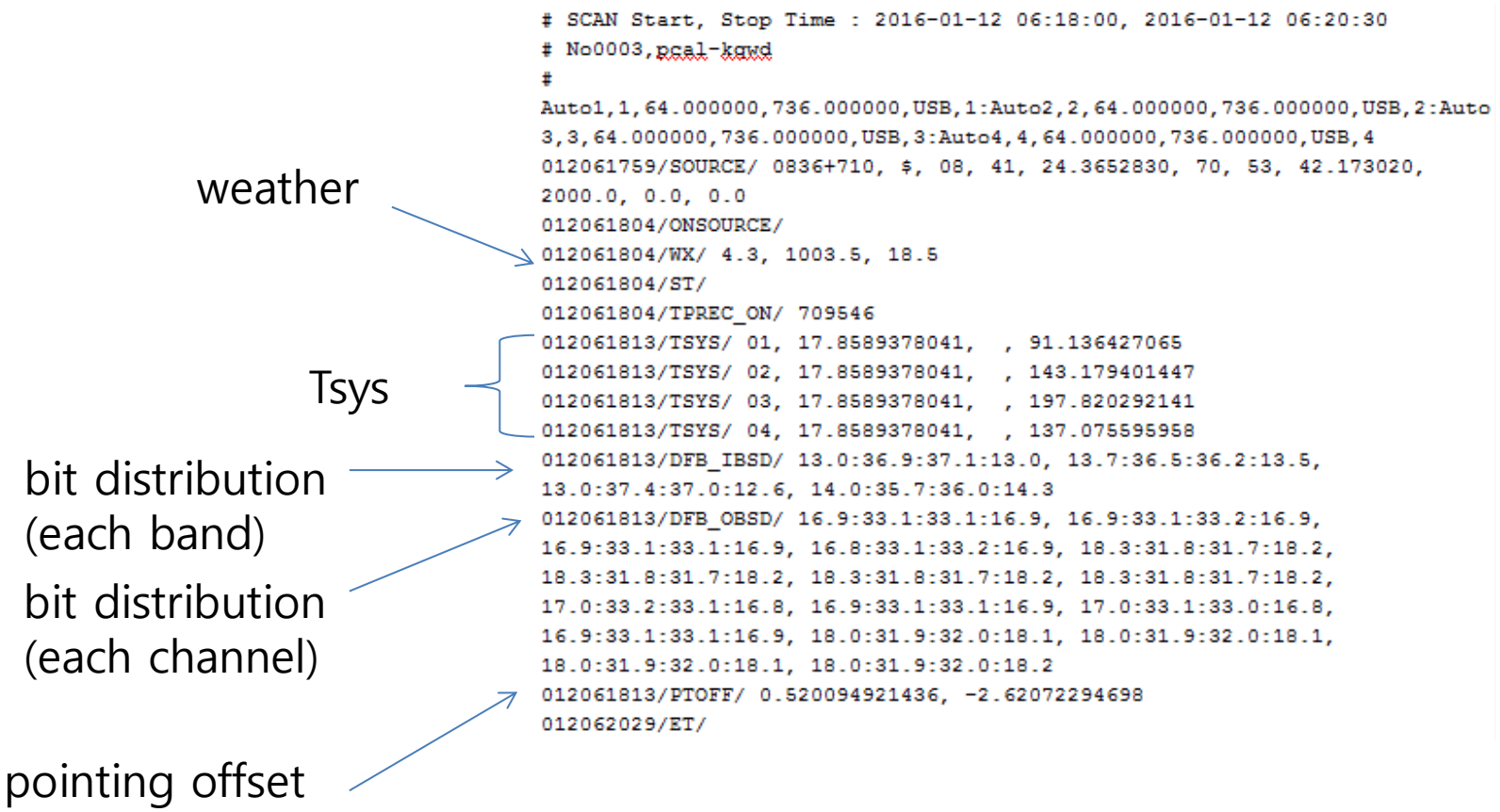
$$T^{*}_{sys} = T_{sys}\ e^{-\tau} = \frac{P_{sky}}{GkB} e^{-\tau} = \frac{P_{sky}}{P_h - P_{sky}} (T_h - T_{sky}) e^{-\tau}$$

$$= \frac{P_{sky}}{P_h - P_{sky}} T_{amb} \eta \left\{ [1 + \frac{\triangle T_{atm}}{T_{amb}} (e^{\tau} - 1)] - \frac{\triangle T_h - (1-\eta) \triangle T_{spill}}{\eta T_{amb}} e^{\tau} - \frac{T_{cmb}}{T_{amb}} \right\}$$

$$\triangle T_{spill} = T_{amb} - T_{spill},\ \triangle T_h = T_{amb} - T_h,\ \triangle T_{atm} = T_{amb} - T_{atm}$$

# Example KVN Station Log

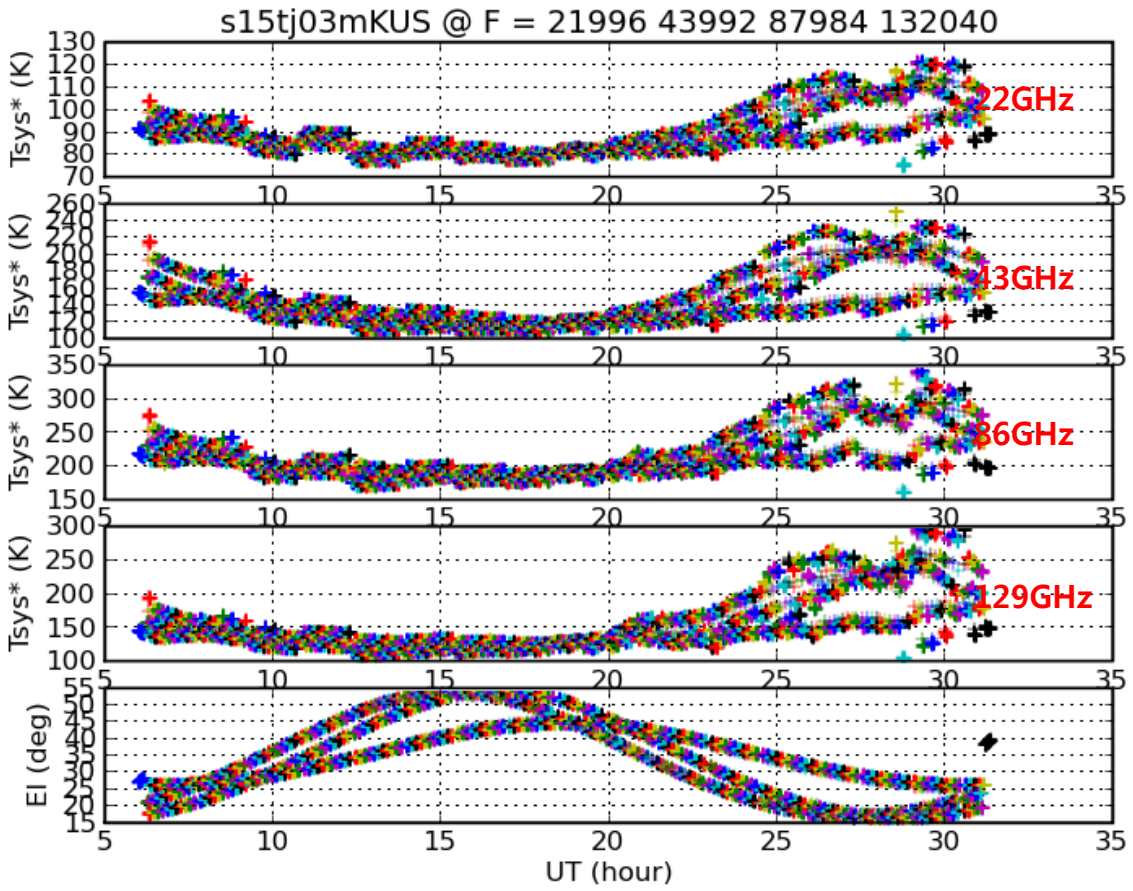
single scan log of 22/43/86/129GHz obs.




```
# SCAN Start, Stop Time : 2016-01-12 06:18:00, 2016-01-12 06:20:30
# No0003,pcal-kqwd
#
Auto1,1,64.000000,736.000000,USB,1:Auto2,2,64.000000,736.000000,USB,2:Auto
3,3,64.000000,736.000000,USB,3:Auto4,4,64.000000,736.000000,USB,4
012061759/SOURCE/ 0836+710, $, 08, 41, 24.3652830, 70, 53, 42.173020,
2000.0, 0.0, 0.0
012061804/ONSOURCE/
012061804/WX/ 4.3, 1003.5, 18.5
012061804/ST/
012061804/TPREC_ON/ 709546
012061813/TSYS/ 01, 17.8589378041,  , 91.136427065
012061813/TSYS/ 02, 17.8589378041,  , 143.179401447
012061813/TSYS/ 03, 17.8589378041,  , 197.820292141
012061813/TSYS/ 04, 17.8589378041,  , 137.075595958
012061813/DFB_IBSD/ 13.0:36.9:37.1:13.0, 13.7:36.5:36.2:13.5,
13.0:37.4:37.0:12.6, 14.0:35.7:36.0:14.3
012061813/DFB_OBSD/ 16.9:33.1:33.1:16.9, 16.9:33.1:33.2:16.9,
16.9:33.1:33.1:16.9, 16.8:33.1:33.2:16.9, 18.3:31.8:31.7:18.2,
18.3:31.8:31.7:18.2, 18.3:31.8:31.7:18.2, 18.3:31.8:31.7:18.2,
17.0:33.2:33.1:16.8, 16.9:33.1:33.1:16.9, 17.0:33.1:33.0:16.8,
16.9:33.1:33.1:16.9, 18.0:31.9:32.0:18.1, 18.0:31.9:32.0:18.1,
18.0:31.9:32.0:18.1, 18.0:31.9:32.0:18.2
012061813/PTOFF/ 0.520094921436, -2.62072294698
012062029/ET/
```

# Example of KVN ANTAB File

```
!--- Gains (DPFUs) ------
!--- GC_VERSION=2013-01-17
GAIN KUS ELEV FREQ=21000,24000 DPFU=0.07686854 POLY=1.01825705,0.00019177,-0.00000438 /
GAIN KUS ELEV FREQ=42000,44500 DPFU=0.07240779 POLY=1.06107499,0.00050293,-0.00001313 /
GAIN KUS ELEV FREQ=84000,96000 DPFU=0.04510304 POLY=1.27425939,0.00123239,-0.00004755 /
GAIN KUS ELEV FREQ=125000,142000 DPFU=0.02252833 POLY=1.55629195,0.00872252,-0.00016559 /
!
!--- Tsys* Data ---------
TSYS KUS FT=1.0 TIMEOFF=0.0 INDEX='L1','L2','L3','L4' /
!DOY UT TSYS*
012 06:00:05 91.972 156.220 219.593 145.878
012 06:00:15 91.875 156.118 219.309 145.801
012 06:00:25 91.886 156.003 219.280 145.696
012 06:00:35 91.855 155.943 219.093 145.498
012 06:00:45 91.785 155.781 218.693 145.310
012 06:00:55 91.747 155.766 218.944 145.251
012 06:01:05 91.754 155.734 218.935 145.277
012 06:01:15 91.789 155.626 218.987 145.148
012 06:01:25 91.743 155.555 218.653 145.145
012 06:01:35 91.783 155.519 218.730 145.218
012 06:01:45 91.773 155.416 218.609 145.154
012 06:01:55 91.741 155.356 218.867 145.091
012 06:02:05 91.751 155.267 218.890 145.034
012 06:02:15 91.701 155.182 218.841 145.138
012 06:02:25 91.733 155.180 218.709 145.247
012 06:02:35 91.774 155.109 218.719 145.341
012 06:02:45 91.798 155.011 218.648 145.535
012 06:02:55 91.759 154.961 218.450 145.402
012 06:03:05 91.682 154.860 218.415 145.205
012 06:03:15 91.588 154.789 218.176 145.012
012 06:03:25 91.574 154.749 218.053 145.045
```




※ Time interval of Tsys* table: 10 sec