


Moon Bounce (EME : Earth-Moon-Earth) Communication




West Malaysia

Moon Bounce Project 2017

JR3REX & 9M2/JG3TTO

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Basic data-

- 1) Distance from Earth to Moon - 384,400Km (9.6 turn of Earth)
- 2) Total travelling distance - 768,800Km
- 3) Signal wave travelling period - 2.56 sec (Earth-Moon-Earth)
- 4) EME (Earth-Moon-Earth) communication is most difficult communication in amateur radio service
 - (1) Antenna System have limit for physical dimension
 - (2) Communication route loss is very big
 - (3) Signal wave flying in space then almost attenuate (768,800Km running)
 - (4) Moon bounce time decay signal also much
 - (5) Most main two reason for attenuate signal
 - a) Signal pass around ionosphere area from Earth / into Earth, big decay.
 - b) Signal polalization when bounce at moon, change direction then decay. Both decay have more than S/N level 20dB loss.
 - (6) We show "Line Budget" calculation as next page

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Moon Bounce Communication Link Budget Data

24-Oct-17
9M2-EME PROJECT.

| Description | Mark | Data | Unit | Remarks |
|--------------------------------|------|--------|------|---|
| Wave length | A | 2.08 | m | 144MHz |
| Transmission output power | Po | 30.0 | dBW | 1KW |
| Transmission cable loss | Lt | -1.0 | dB | 10D(15m)/8D(6m)/connector |
| Transmission antenna gain | Gt | 19.0 | dBi | 11elements Yagi X2 (Horizontal, Vertical) |
| Mika effect of radiation power | EIRP | 48.0 | dBW | |
| Vale move loss | F | -251.8 | dB | Refer (2) |
| Receiving antenna gain | Gr | 19.0 | dBi | Same as Transmission antenna gain |
| Receiving cable loss | Lr | 0.0 | dB | Add receiveing pre-amplifier |
| Receiving signal level | Pr | -184.8 | dBW | Refer (3) |
| Receiving noise level | Pn | -184.9 | dBW | Refer (4) |
| Signal-Noise ratio | S/N | -0.1 | dB | Pr/Pn |

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(5) Link budget requirement

Current ideal Signal-Noise Figure is 0.1dB.

But, usually there is 20dB and more fading loss by an ionosphere and polarization angle.

So, power margin is needed.

This means just normal receiving signal level need 1KW out put.

This link budget is required to calculate for own "ECHO" signal receiving in order to make contact.

But! This time I could not get 1KW output power license from MCMC.
Current my 9M2 license is only available **50W!**

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Line Budget have S/N ratio only -12.9dB when 50W output
And related loss about 20dB

Total S/N level -32.9dB!

This is means I cannot communicate thru Moon bounce
Recently K1JT (Dr. John Taylor) developed WSJT software which usage for EME weak signal communication.

But WSJT software is only able to decode signal up around -27dB (no enough 5dB..)

I cannot make to listen my "Echo" signal

=====> **I think this system have possibility for make QSO**

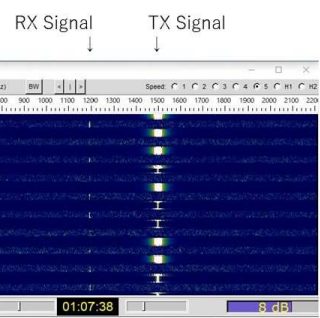
Because another station antenna system have better gain than me.

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<ECHO TEST> SEQUENCS: 3sec TX-> 2sec RX



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<Schedule>

- Nov-1 JR3REX (Mr. Tsuboi as EME Specialist) arrive from Japan
Check in Segamat Country Club guest house
- Nov-2 AM/PM Set up EME Antenna (22ele cross Yagi antenna X2)
PM Set up EME Radio equipment
- 18:00- Start Operation
- Nov-3 to Nov-6 EME Operation
- Nov-6 Antenna/System tear down and leave operation place

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<Antenna System>



22ele Cross Yagi (11el x2) X2

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<Antenna System>



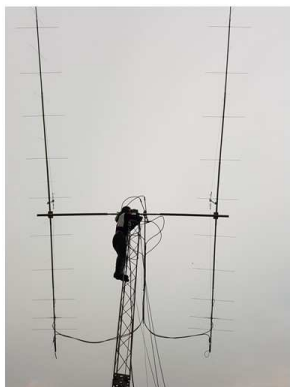
22ele Cross Yagi (11el x2) X2



Set up condition

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Set up antenna

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Set to Moon

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Setting Rig

Rotator controller
Azimuth & Elevation

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<EME QSO SEQUENCE>

CQ 9M2/JG3TTO
 ↓
 ZS5HV call to 9M2/JG3TTO
 ↓
 9M2/JG3TTO reply with "OOO"
 ↓
 ZS5HV reply only "RO"
 ↓
 9M2/JG3TTO reply only "RRR"
 ↓
 ZS5HV reply only "73"

ZS receiving level : -26dB

WSJT 9.7 v3639 by K1JT

File Setup View Mode Decode Save Band Help

Moon
 Az : 40.47
 El : 76.33
 Dop : 234
 Dgrd : -2.4

| Freq | Sync | dB | DT | DF | W | Mode | Call | Rate |
|--------|------|-----|------|-----|----|------|------------------|------|
| 163700 | 0 | -33 | 5.8 | 221 | 29 | | | |
| 163900 | 0 | -33 | 2.4 | 13 | 47 | # | | |
| 164100 | 0 | -33 | -1.5 | 27 | 47 | | | |
| 164300 | 2 | -24 | 1.7 | 11 | 3 | * | 9M2/JG3TTO ZS5HV | 0 10 |
| 164500 | 10 | -22 | 7 | 2 | 80 | | | |
| 164700 | 10 | -10 | 5 | 4 | 73 | | | |

Log QSO Stop Monitor Decode Erase Clear Avg Include Exclude TxStop

To radio: ZS5HV Lookup Sync -2 Z40 ZSHV 9M2/JG3TTO TX1

Grid: KFS9y Add Tel 50 AFC ZSHV 9M2/JG3TTO OOO TX2

Az: 238 8441 km Freeze RRR TX3

2017 Nov 04 16:48:02 Desc 0.0 Gen Heps 73 TX4

CO 9M2/JG3TTO TX5

1.0000 1.0000 370Hz Freeze DF: 15 Rx noise: 0 dB T/R Period: 60 s Tung RRR

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<QSO with JA>

1. Operating period 2-Nov (Thu) to 6-Nov (Mon) morning = 4nights
2. Total QSO : **111 QSO!**
 5 Continent (except SA)
 28 Entity

| | | | | | | | | | |
|----|-----|---|----|-------|----|-----|---|----|---|
| AS | JA | 8 | EU | DL | 18 | OH | 4 | LA | 1 |
| NA | W | 3 | | PA | 10 | YO | 3 | LY | 1 |
| AF | ZS | 5 | | SM | 9 | ES | 2 | OK | 1 |
| AF | EAS | 1 | | UR | 9 | F | 2 | ON | 1 |
| OC | VK | 1 | | RA-EU | 8 | LZ | 2 | OZ | 1 |
| | | | | S5 | 6 | SP | 2 | SV | 1 |
| | | | | G | 5 | EA | 1 | YU | 1 |
| | | | | I | 4 | HB9 | 1 | | |

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<QSO with USA>

W receiving level : -25dB

<QSO with EU>

ES receiving level : -25dB

WSJT X v3639 by K1JT

File Setup View Mode Decode Save Band Help

Waterfall plot showing signal at 12.2557 MHz.

Moon
Az: 74.59
El: 3.73
Dop: 97
Dgrd: -3.0

W7OL_17116L_122500

| Freq | Sync | dB | DT | DF | W | Mode | Power |
|--------|------|-----|-----|----|-----|----------------|-------|
| 121900 | E | -19 | 1.6 | 62 | 3 * | RM/3S3TTO W7GJ | 1 10 |
| 121700 | E | -22 | 1.6 | 62 | 3 * | RM/3S3TTO W7GJ | 1 10 |
| 121900 | E | -16 | 1.6 | 62 | 3 * | RM/3S3TTO W7GJ | 1 10 |
| 122100 | 10 | -11 | | 61 | 3 | 80 | |
| 122300 | 10 | -13 | | 61 | 3 | 80 | |
| 122500 | 10 | -11 | | 62 | 5 | 73 | |

Log QSO Stop Sync Decode Erase Clear Avg Include Exclude TxStop

To radio: W7OL Linkup
Gnd: CH276 Add
Az: 39 13433 km
Dec: 0.2

2017 Nov 05 12:25:57
Dec: 0.2

1.0000 1.0000 17658 Freeze CF: 69 Rx noise: 0 dB T/R Period: 60 s

WSJT X v3639 by K1JT

File Setup View Mode Decode Save Band Help

Waterfall plot showing signal at 15.5055 MHz.

Moon
Az: 288.19
El: 86.40
Dop: 154
Dgrd: -2.5

E66RQ_17116L_155000

| Freq | Sync | dB | DT | DF | W | Mode | Power |
|--------|------|-----|------|-----|-----|------------------|----------|
| 154200 | 0 | -10 | -0.5 | 148 | 6 * | RM/3S3TTO UR1DNW | 1 10 |
| 154200 | 5 | -14 | 1.6 | 136 | 4 * | RM/3S3TTO UR1DNW | 1 10 |
| 154400 | 8 | -10 | 1.6 | 129 | 3 * | RM/3S3TTO UR1DNW | 1 10 |
| 154600 | 6 | -13 | 1.6 | 140 | 1 # | RM/3S3TTO E66RQ | 000 1 10 |
| 154800 | 10 | -54 | | 139 | 5 | 80 | |
| 155000 | 10 | -21 | | 137 | 8 | 73 | |

Log QSO Stop Sync Decode Erase Clear Avg Include Exclude TxStop

To radio: E66RQ Linkup
Gnd: K0296w Add
Az: 328 9009 km
Dec: 0.2

2017 Nov 02 15:50:55
Dec: 0.2

1.0000 1.0000 17658 Freeze CF: 138 Rx noise: 0 dB T/R Period: 60 s

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