G1061 pFBAAVTREmiSafeBgHpA CMVrtTAwtIRESeGFPSV40pA Inducible miRNA Plasmid Control

Plasmid Features:

Coordinates	Feature
194-348	Tn7L
376-511	SV40pA (complementary -outside ITRs)
678-818	AAV2 ITR (141bp)
878-1193	TRE Tight promoter Clonetech
1211-1296	miSafe
1325-1556	BgHpA
1632-2211	CMV Promoter
2240-2992	rtTA Advanced Tet On Transactivator Clonetech
3007-3593	wtIRES
3594-4313	EGFP
4386-4522	SV40pA
4594-4723	AAV2 ITR (130bp)
5280-5813	Gentamicin
5880-6104	Tn7R
7168-8028	B-lactamase (Ampicillin) Complementary

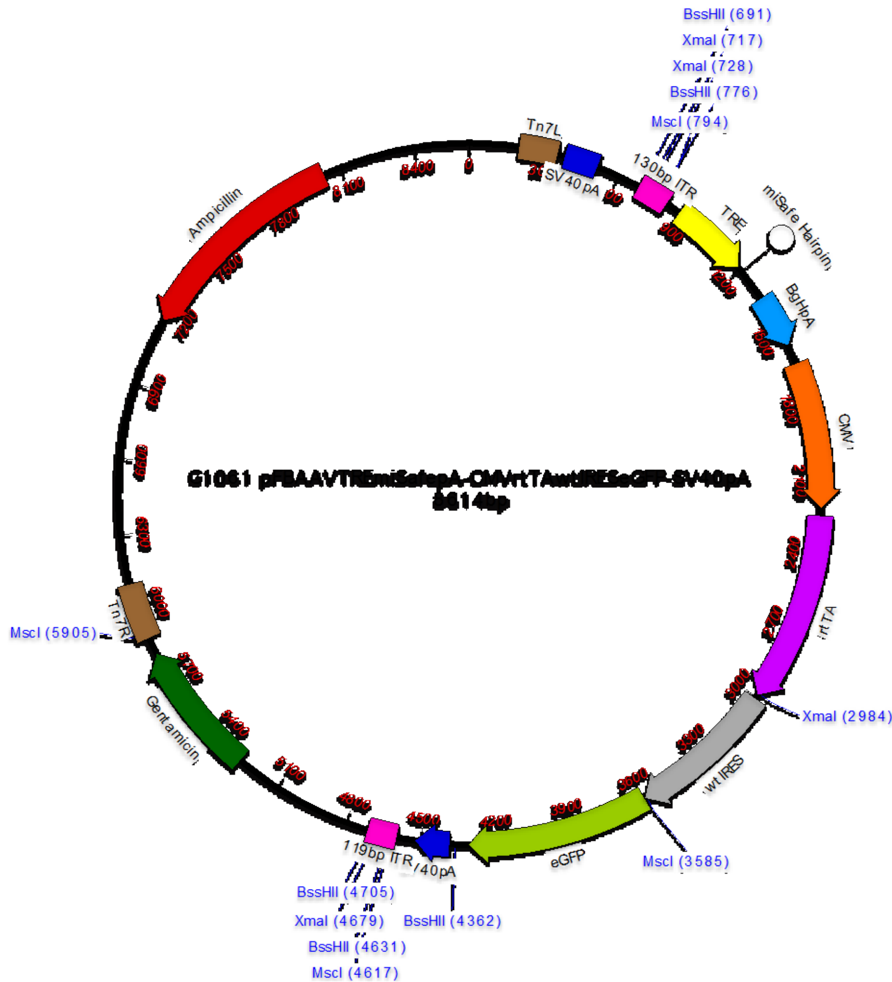
Antibiotic Resistance: Ampicillin and Gentamicin
Bacterial Backbone: pFastBac™ Invitrogen
TREtight: Clonetech
rtTA Advanced: Clonetech

Note: To check the integrity of the AAV ITR's perform single restriction enzyme digestions with XmaI, BssHII, and MscI.

This vector was designed with EGFP under the constitutive expression from the CMV promoter for tracking while the expression of the miRNA cassette can be inducibly driven by the tetracycline-regulated TRE promoter for RNA interference (RNAi) analysis in mammalian cells.

miSafe is a scrambled control developed by Ryan Boudreau in the lab of Beverly Davidson.

Please reference: Boudreau, R. L., et al. (2011). "Rational Design of Therapeutic siRNAs: Minimizing Off-targeting Potential to Improve the Safety of RNAi Therapy for Huntington's Disease." Mol Ther 19(12): 2169-2177.



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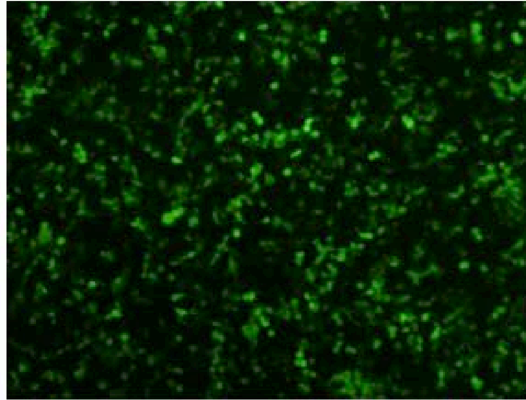
Quality Control Plasmid Transfection:

Lipofectamine LTX Transfection in HT1080 Cells
7-16-14 @ 24 hrs 0.7x10⁶ c/well in 6 well plate



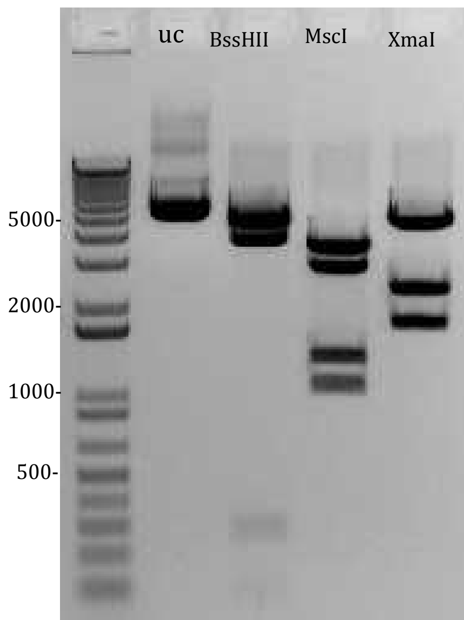
G1061 pFBAAVTREmiSafeBgHpA-
CMVrtTAwtIRESeGFP-SV40pA
2ug/well

Quality Control Plasmid ITR Digest:

7-10-14 miniprep 1 @ 432ng/ul
Expected fragments:

1. 1Kb+ ladder
2. uncut
3. BssHII: 4600, 3586, 269, 85, 74
4. MscI: 3503, 2791, 1288, 1032
5. XmaI: 4652, 2256, 1695, 11

Aldevron Maxi Lot 51905 7/17/14



Background:

This vector was designed with two independent cassettes. 1. TRE-miRNA-BgHpA and 2. CMV-rtTA-wtIRESeGFP. The dox inducible, tetracycline-regulated TRE promoter drives the miRNA cassette. Constitutive expression from the CMV promoter drives the rtTA transactivator and the expression of eGFP for tracking. In the absence of induction according to the originator Clonetech, the Tet-On Advanced transactivator shows virtually no residual binding to the TRE in P_{Tight}. Thus, basal expression is extremely low.

Please refer to the original Clonetech guides for useful information on working with the Tet-On Advanced System:

Tet-On Advanced Inducible Gene Expression Systems User Manual #PT3898-1_102312-7
http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=7&ved=0CGcQFjAG&url=http%3A%2F%2Fwww.clontech.com%2Fxxclt_ibcGetAttachment.jsp%3FcItemId%3D17561&ei=3LupU6jCJsWfqAbksILoCA&usg=AFQjCNEQOJMoyr4OPqqXaaOPcwNbudctcA&bvm=bv.69620078,d.b2k

Mir-XTM Inducible miRNA Systems User Manual #PT5050-1
http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCIQFjAA&url=http%3A%2F%2Fwww.clontech.com%2Fxxclt_ibcGetAttachment.jsp%3FcItemId%3D17566&ei=rMCpU8ftB9KXqAb4mYGAAg&usg=AFQjCNGq-fljnWOPOihXdi0Q0VTfaHbdVw&bvm=bv.69620078,d.b2k

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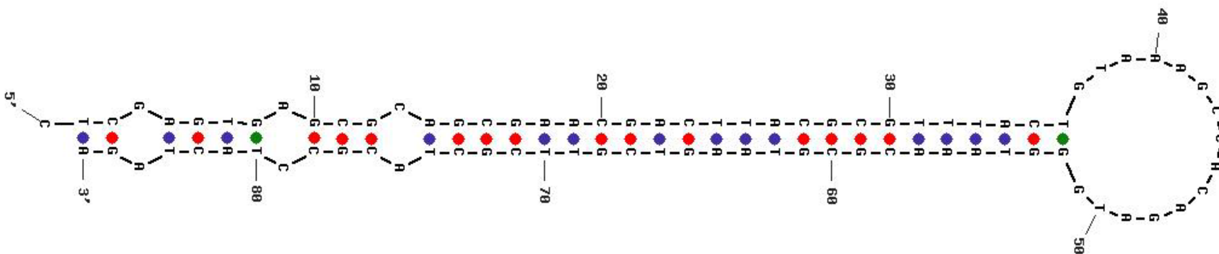

mU6miSafe cassette EcoRI mU6 promoter miSafe Pol III Terminator EcoRI

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miSafe Hairpin

XhoI linker antisense common loop sense linker SpeI/XbaI

CTCGAGTGAGCGCAGCGAACGACTTACGCGTTTACTGTAAAGCCACAGATGGGTAAACGCGTAAGTCGTTCGCTACGCCTACTAGA

miSafe designed by Ryan Boudreau and Beverly L. Davidson

aaaactcgagtgagcgcagcgaacgacttacgcgtttactgtaaagccacagatgggtaaacgcgtaagtcgttcgctacgcctactag**ttttt**

```
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   3'...UCAU CGC UCGCUUGCUGAAUGCGCAAAUGG      C
           C   A                      GUAGACA
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Oligo 1: aaaactcgagtgagcgcagcgaacgacttacgcgttta<u>ctgtaaagccacagatggg</u>

Oligo 2: aaaaactagtaggcgtagcgaacgacttacgcgtttacccatctgtggctttacag
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Cumulative Distribution Antisense Seed Complements: TACGCGTT, ACGCGTTT, CGCGTTTA

References:

Boudreau RL, Spengler, RM, Davidson BL. **Rational Design of Therapeutic siRNAs: Minimizing Off-targeting Potential to Improve the Safety of RNAi Therapy for Huntington's Disease.** Mol Ther. 2011 December; 19(12): 2169–2177.

Harper SQ, Davidson BL. **Plasmid-based RNA interference: Construction of small-hairpin RNA (shRNA) expression vectors.** Methods Mol Biol 309:219-235, 2005.

Harper SQ, Staber PD, Beck CR, Fineberg SK, Stein CS, Ochoa D, Davidson BL. **Optimization of Feline Immunodeficiency Virus Vectors for RNA Interference.** J Virol 80(19):9371-9380, 2006.

Generation of hairpin-based RNAi vectors for biological and therapeutic application. Boudreau RL, Davidson BL. Methods Enzymol. 2012;507:275-96. Review. PMID: 22365779 [PubMed - indexed for MEDLINE]
http://www.sciencedirect.com/science/article/pii/B9780123865090000144

siSPOTR: a tool for designing highly specific and potent siRNAs for human and mouse. Boudreau RL, Spengler RM, Hylock RH, Kusenda BJ, Davis HA, Eichmann DA, Davidson BL. Nucleic Acids Res. 20 print] PMID: 22941647 [PubMed - as supplied by publisher]

siSPOTR (siRNA Sequence Probability-of-Off-Targeting Reduction)
https://sispotr.icts.uiowa.edu/sispotr/index.html;jsessionid=E8EB7B91C5640FD84F7E72DC758505DD

Translational efficiency of EMCV IRES in bicistronic vectors is dependent on IRES sequence and gene location. Yury A. Bochkov and Ann C. Palmenberg. BioTechniques 41:283-292, 2006.

Information and Cloning Suggestions for Working with pFBAAV Plasmids:

Characteristics of AAV:
Adeno-Associated virus (AAV) is a non-pathogenic helper dependant parvovirus. This is one of the most promising vehicles for gene delivery. Recombinant AAV vectors have predominantly episomal gene expression. AAV has long term expression in terminally differentiated cells. It can infect a wide range of cells, including non-dividing cells.

Insert Size:
The major disadvantage of the AAV vectors is the small genome, which limits the size of the transgene (from ITR to ITR) to about 4.7 Kb. Please consider the size of the promoter, polyA, any reporters, and your gene of interest when planning the cloning into an AAV shuttle vector. When the length of inserted DNA between the 2 ITRs is close the maximal allowed, i.e., 4.7Kb, the packaging efficiency decreases significantly.

AAV Production:
The University of Iowa Viral Vector Core uses two systems for AAV production: A Triple Transfection System and the Baculovirus System.

The Triple Transfection System may be used with any pAAV plasmid including the pFBAAV plasmids. A pHelper plasmid isolated from adenovirus, a Rep/Cap plasmid, and the AAV ITR plasmid package containing the gene of interest are transfected into 40 x 150mm plates of adherent 293FT cells per prep. This system is more labor intensive for production and purification but can be completed within three to four weeks of receiving the plasmid.
The services provided for production are:

- Transfection.
- Large-scale amplification of AAV vectors.
- The AAV vector is purified using either CsCl or an iodixanol gradient followed by ion-exchange or affinity chromatography.
- A physical titer in viral genomes per ml (vg/ml) is assessed by QPCR.
- **Sample required**: 1500ug of high quality AAV plasmid expressing the gene of interest at a concentration greater than 0.25ug/ul per prep. One disadvantage to the investigator in the triple transfection system is having to provide 1500ug of DNA for each subsequent prep and the possibility of recombination during the maxi prep process. Each maxi prep should be digested and evaluated for integrity.

The Baculovirus System can only be used with pFBAAV plasmids with Tn7 transposable elements to incorporate the ITRs and gene of interest into the Bacmid DNA. *Please note: not all AAV plasmids contain the Baculo elements so this system may not be an option for everyone. This system also relies on the gentamicin selection marker within the transposable elements. The system was developed by Dr. Robert Kotin at the National Institute of Health. The system is described in the following publication: "*Insect Cells as a Factory to Produce Adeno-Associated Virus Type 2 Vectors"* Human Gene Therapy 13:1935-1943 (November 1, 2002). The Baculovirus System takes 5-6 weeks for production but has many advantages. The Baculovirus System can tolerate more toxic proteins driven by mammalian promoters as these promoters will not be active in the insect cells. This system is also generally more robust with higher titers, cost-effective, and less labor intensive for production. Once we have a Baculovirus stock of the investigator package, we can make additional preps readily and we have tested the Baculovirus stock to be stable for years.
The services provided for production are:

- Transposition of the gene interest into the DH10Bac bacmid DNA. Everything in the pFBAAV plasmid between the transposable elements (Tn7, ITR, Promoter, gene of interest, pA, ITR, gentamicin resistance, Tn7) is incorporated into the large 135,000kb bacmid DNA. Your plasmid must be gentamicin resistant for the transposition to work.
- Growth and midi prep preparation of Bacmid DNA.
- Transfection of the Bacmid DNA with gene of interest into Sf9 cells. Approximately 12mls of the P1 stage Baculovirus is harvested 5 days later.
- Titer of the Baculovirus P1 stock. We are able to make 1-3 preps of final AAV virus using the P1 stock depending on the titer of the stock and the desired MOI of infection for the final AAV prep.

- For multiple AAV virus preps the P1 stock is amplified to a larger volume P2 Baculovirus stock and titered.
- The final AAV virus is prepared in bioreactor bags on a rocker platform by dual infection with the package Baculovirus and the desired Rep/Cap Baculovirus into Sf9 cells. The Baculovirus provides pHelper function. The culture is harvested 3 days later.
- The AAV vector is purified using either CsCl or an iodixanol gradient followed by ion-exchange or affinity chromatography.
- A physical titer in viral genomes per ml (vg/ml) is assessed by QPCR.
- **Sample required**: 10ug of pFBAAV plasmid expressing the gene of interest at a concentration greater than 0.25ug/ul.

Bacterial Backbone:
All of our internal AAV plasmids contain Baculo compatible elements from Invitrogen pFastBac™. For information on the pFastBac backbone and the Baculovirus System, please review the Invitrogen manual: http://tools.invitrogen.com/content/sfs/manuals/bactobac_topo_exp_system_man.pdf
**Please note: not all AAV plasmids are compatible with the Baculo system.

ITRs (Inverted Terminal Repeats):
The ITRs for AAV were engineered into the Invitrogen pFastBac backbone by Dr. Robert Kotin.

Orientation and Updates:
The MCS and BgHpA were inserted in the antisense direction relative to the Invitrogen backbone and ITRs. Please note that the backbone and ITRs were re-sequenced and updated in 2012 and there are several changes. Please discard any older sequences. The nomenclature of 5'ITR (130bp) and 3'ITR (141bp) have been retained on some maps to identify the sequences. The orientation of the ITRs makes no difference to the formation of the viral vector.

Recombination:
Recombination is a possibility at both the transposable elements (Tn7L and Tn7R) and the Inverted Terminal Repeats (ITRs) in the pFBAAV plasmid. In order to check for and reduce the chance of recombination, we have the following recommendations.

<u>Antibiotic Resistance:</u>
The gentamicin resistant gene lies within the transposable elements and may be lost if the transposable elements recombine. We suggest using **both ampicillin and gentamicin** selection on plates and in your liquid media throughout the cloning process and during amplification to midi or maxi preps.
Ampicillin concentration: 100ug/ml final
Gentamicin Sulfate concentration: 7ug/ml final

<u>E. Coli Competent Cell Recommendations:</u>
We recommend using a stable E. coli strain such as **SURE2, Stable2, or Stable3** for transformation of your final plasmid product. These competent cell strains have been engineered to stop unwanted rearrangement events and lack the components of the pathways that catalyze the rearrangement and deletion of nonstandard secondary and tertiary structures, including cruciforms (caused by inverted repeats) and Z-DNA, that occur frequently in eukaryotic cells. Cloning, however, can be difficult in these strains. We recommend DH5a competent cells for sub-cloning.

Quality Control ITR Digest:
We <u>require</u> a quality control digest of the plasmid upon submission to ensure that there is no recombination before vector production is started. The ITRs in the pFBAAV plasmids have several convenient restriction sites to determine whether the ITRs are intact without sequencing. Sequencing the ITRs can be difficult due to their hairpin secondary structure. We suggest a single digest each of **BssHII, MscI, and XmaI**. It is a good idea to also run un-cut and linearized plasmid next to these digests. Determine your expected fragment sizes for each digest and check carefully to see that you get what you expect and have no extraneous bands. Be sure to check your final midi or maxi product (not just your miniprep) as recombination is possible during any amplification process.

Sequencing pFBAAV plasmids and ITRs
The majority of the plasmid and insert can be sequenced normally. Sequencing of the ITRs is difficult but possible. Sequencing of the ITRs or other difficult secondary structures may be aided by requesting "Extended Denaturation" or by requesting "Betaine Chemistry for AAV ITRs" in the comments section at the University of Iowa Sequencing Core. Non-UI investigators should consult with their own sequencing facility for help if sequencing of the ITRs is desired. We routinely request "Extended Denaturation" for all AAV plasmid sequencing.

There is no one set of primers that will always sequence through the ITRs. The ITR primers listed below have been used with success in many cases. Try sequencing in both directions: from the plasmid in and from your insert out.

Suggested Sequencing Primers for a variety of pFBAAV plasmids:
Below is a general list of commonly used primers at the University of Iowa Viral Vector Core. Please check to make sure the primers work for the shuttle plasmid you have received. There are many free primer design programs available to design primers that will sequence your insert.

BgHpA For	TGAGGAAATTGCATCGCATTGTCT
BgHpA Rev	AGGAAAGGACAGTGGGAGTG
pFBAAV (130bp ITR)	GCCTTGCTGTTCTTCTACGG
pFB587F (141bp ITR)	CTCTACAAATGTGGTATGGCTG
pFB214F (141bp ITR)	GGGGTGGAAATGGAGTTT
pFB158F (141bp ITR)	CATAACAGGAAGAAAAATGCCCCG
EGFP-141Rev	GAACTTCAGGGTCAGCTTGCCGTA
EGFP-651For	TCACATGGTCCTGCTGGAGTT
IRES Rev	CTCACATTGCCAAAAGACG
mU6 For	ACAGACTTGTGGGAGAAGC
CMV Rev	GTAGGAAAGTCCCATAAGGTCA
CMV For	GTGGGAGGTCTATATAAGCAGAGCTCG
IRESfor	GTTGTGAGTTGGATAGTTGTGG

Please contact us with any questions:

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